PREVIEW OF IOWA ASPHALT TREATED BASE CONSTRUCTION

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INTRODUCTION

During the 1961 construction season the Iowa State Highway Commission undertook the use of a comparatively new type of base material for flexible pavement construction. It has been called Asphalt Treated Base.

Without going into the design features in detail, which is not the purpose of this discussion, the Asphalt Treated Base material consists of pre-heated fine material, either stone or gravel, and coarse crushed stone aggregates, in which pre-heated 120-150 penetration grade asphalt is mixed at a central mixing plant. This material differs from the Commission's Bituminous Treated Aggregate Base in that the mix must use asphalt cement and be laid hot and the mixture be of at least 70% crushed stone particles.

The Commission's Specifications does allow the Bituminous Treated Aggregate Base to consist of gravel or crushed limestone, or both, combined with sand and a filler material and can be laid hot or cold depending on the type of asphalt used.

The first project let by the Commission was six and one-half miles in length in Jones County on State Highway No. 136 from the Town of Onslow north to the Maquoketa River. The project consisted of correcting the subgrade, both soil-aggregate and granular subbase, six inches of Asphalt Treated Base, and three inches of Type B Asphaltic Concrete Surface course. The total design thickness was fifteen inches. The project was opened to traffic in late July of 1961 during the shouldering operations and after many days of inclement weather was completed and accepted on September 9, 1961.

A second project was subsequently let for construction in Cedar County on Interstate Route I-80 from the Cedar River westerly eight miles. The work on this project

involves the correcting of subgrade, sixteen inches of Asphalt Treated Base, and four and one-half inches of Type A Asphaltic Concrete Binder and surface courses. In addition, the shoulders are to be constructed of eight inches of Asphalt Treated Base placed on Moisture Density controlled earth fill. The contract involves over 400,000 tons of Asphalt and is one of the largest of its type tonnage-wise ever let in the continental United States. The contract was let in early fall of last year and the contractors' progress was above average amounting to the incorporation of around 170,000 tons of Asphalt Treated Base into the work before being forced to shut down his operation for the winter months. It is the hope of everyone concerned that this project will be completed by early summer of 1962.

The procedure used to incorporate the Asphalt Treated Base into the work went through very little evolution on either of the two projects. Substantially the same procedures were used by both contractors with equal success.

As on all new work, a few new construction practices are developed along with the use of previously proven procedures or perhaps slight variations of them. Therefore, it will be our intention during the next few minutes to discuss briefly the preliminary phases of work done prior to laying the Asphalt Treated Base and to then outline in detail the construction procedures utilized to incorporate the Asphalt Treated Base into the work on the two projects mentioned earlier. In all instances the procedures used were in agreement with the Iowa Specifications or if not specifically covered in the Specifications proper authority was obtained for their use.

GENERAL COMMENTS ON CONSTRUCTION PROCEDURES

The Asphalt Treated Base construction procedures established on the Jones County project proved to be economical with good production. Therefore, it is felt by both the contractors and Highway Commission personnel a feasible method of laying Asphalt Treated Base has been found for Primary highway work.

These same methods of laying Asphalt Treated Base on the Interstate project have been used successfully to its point of completion but further problems not encountered on the Primary work are yet to be faced and solved. For instance, the problem as how to attain a nice appearing, compacted 4 to 1 Asphalt Treated Base shoulder slope along with true shoulder edge alignment must yet be solved next spring. Also, the reorientation of both the contractors men and Highway Commission personnel on the conversion from laying Asphalt Treated Base, with its rather open specifications, to laying Type A Asphaltic Concrete, with its more technical specifications, will defintely present a major problem.

As the less tedious work is well on its way to completion on the Interstate project and with the many problems still to be encountered, perhaps a construction procedure report is slightly premature on that work at this time.

With these facts in mind, this discussion will limit itself to the actual construction procedures used to date.

SUBGRADE AND SUBBASE CONSTRUCTION

The correction of subgrade on the Jones County project was built as outlined in the Iowa Specifications for that item. That is, the surface of the roadbed was corrected both in grade and cross section to within a tolerance of a plus or minus 0.05 of a foot. Any material moved in this operation also had to be consolidated so that the subgrade was smooth, compacted earth. When this phase was completed the soil-aggregate or granular subbase was then constructed according to the Iowa Specifications for those items.

On the Interstate project the contract documents stipulated additional work on the correction of subgrade due to not utilizing any subbase on the design thickness plus the fact that the grading phase had not been completed when this project was let.

The correction of subgrade included the scarification of the roadbed resulting in a uniformly cut smooth surface of plane on the bottom of the scarified material. This scarified material was then pulverized so that the largest soil particle did not exceed two (2) inches in maximum dimension. The material was then brought to within a plus 2 or minus 4 percentage points of optimum moisture, reshaped so that after compaction to maximum density the surface conformed within 0.05 of a foot to the desired grade and was a minimum of six (6) inches in depth of compacted material. It was found on both projects these items of contract work progressed very rapidly and without undue delay.

PRIMING SUBGRADE AND SUBBASE

The Jones County project soil-aggregate subbase was such a dense material the RC-O priming asphalt would not penetrate or cure in a reasonable time at the specified rate of 0.2 of a gallon per square yard. The purpose of priming was obtained with a rate of approximately 0.15 of a gallon per square yard. This rate gave the prime sufficient penetration and cured within twenty-four (24) hours to allow traffic so that work on the Asphalt Treated Base could begin.

The priming of the Interstate subgrade with RC-O proceeded as planned with the specified rate of 0.2 of a gallon per square yard doing an excellent job.

GENERAL SPEC. ON ASPHALT TREATED BASE

The specifications for laying the Asphalt Treated Base were the same for both the Jones County Primary and Cedar County Interstate projects.

The hot mixture of Asphalt Treated Base was to be placed on all areas of uniform width by means of a finishing machine with the first lift being two (2) inches of compacted thickness with 5% asphalt and each subsequent lift to be not greater than three (3) inches of compacted thickness with 4% asphalt. The maximum forward speed

of the finishing machine was not to exceed sixty (60) feet per minute and the rate adjusted to insure continuous placement operation. The first two (2) inch lift was to be compacted to 92% of laboratory density and each subsequent lift compacted to 95% of laboratory density.

The Engineer also was to have authority to order tacking with RC-O of the surface of each layer of Asphalt Treated Base to insure bond between layers of base material. Upon completion of the Asphalt Treated Base the edges slope and adjacent one (1) foot of subgrade on each side was to be primed with RC-O at the rate of 0.3 gallon per square yard and allowed to cure. The Engineer then has the option to prime, at the rate of 0.15 gallons per square yard, or apply a light tack coat to the top surface, edge slopes and adjacent one (1) foot of subgrade. The Engineer may also eliminate this entire last operation if, in his opinion, it is not needed.

These statements represent a few of the more basic and important specifications but by no means include the entire range of specifications as set up by the Commission.

PLACING ASPHALT TREATED BASE

From the inception of these projects, the Commission designers confidently thought the use of a soil-aggregate or granular subbase, which was used on the Jones County work, plus the application of the first two (2) inches of Asphalt Treated Base would be sufficient to withstand the contractor's highly concentrated loads due to rolling and hauling without failures. They also considered the working of the subgrade on the Interstate project, as mentioned earlier, sufficient to insure a minimum number of failures after the first two (2) inches of Asphalt Treated Base was laid.

This design theory proved to be successful on the Jones County project with only a small number of failures showing up due to hauling after the first two (2) inches were placed.

However, due to an unusually high ground water table with resulting saturated soil, considerable number of subgrade failures were found on the Interstate project while laying the first two (2) inches of Asphalt Treated Base on accepted subgrade. Upon occasions failures would show up even after the second layer or a total of five (5) inches of Asphalt Treated Base were placed.

The contractor very wisely decided to use the adjacent shoulders for his haul road for the loaded trucks until a sufficient depth of Asphalt Treated Base had been laid to hold up without failure. This required strength was generally obtained after five (5) inches of Asphalt Treated Base had been placed.

In actual placing of the Asphalt Treated Base, conventional asphalt finishing machines were used with an aid of an offset stringline set for alignment. This is the same procedure used for a number of years by the Iowa State Highway Commission to place Type A or Type B Asphaltic Concrete.

The softness of the 120-150 Penetration Grade Asphalt did provide one unexpected benefit on the Interstate work. With most standard asphalt laydown machines, the maximum width for an efficient operation is fourteen (14) feet. Any additional width requires lengthening the screed with extensions which are time consuming to install. As the first two (2) inches of the Asphalt Treated Base had a total width of twenty-eight (28) feet six (6) inches , everyone at first thought extensions would have to be used. However, as the Asphalt was of a soft grade, it was found the "spread" or "squeeze-out" due to rolling allowed the use of two fourteen (14) feet lay-down machine widths to obtain the required width of twenty-eight (28) feet six (6) inches. In other words, the Asphalt Treated Base spread approximately three (3) inches on each fourteen (14) foot lane. Thus the screed extensions were not needed, with resulting time saving of their installation and removal, to begin laying the subsequent lift of Asphalt Treated Base. By being able to use the fourteen (14) foot width to lay the first course, it was

a simple screed cutoff shoe installation to obtain the required width of the next layer of Asphalt Treated Base.

Although the spread of the Asphalt Treated Base under rolling was beneficial in this case, the projects were continually confronted with the problem of nonuniform spread. From day to day, or even hour to hour, it was very difficult to anticipate this spread. The inability to predetermine the spread of the Asphalt Treated Base often left one edge slope appearing like stairs produced by each layer placed instead of the desired 45° slope. The spread not only presented a problem when laying a course of varying thickness for leveling purposes, but also when a uniform lift was being applied.

As stated previously, the maximum traveling speed of the finishing machine, according to the Specifications, was not to exceed sixty (60) feet per minute. On an experimental basis, the contractor was allowed to exceed this speed for a few minutes on the Interstate project. Finishing machine speeds of up to ninety (90) feet per minute were used with no apparent sacrifice of quality control or of a continuous laying operation.

Perhaps the most interesting and unusual feature on the Interstate project was the use of two finishing machines in tandem to lay adjacent lanes of Asphalt Treated Base. The two laydown machines were staggered at intervals of twenty-five (25) to fifty (50) feet. This procedure worked extremely well with excellent results obtained. The only laydown problem was that of getting the hauling units into and away from the finishing machines with work being done on both lanes. In order to protect the edges of the previously placed Asphalt Treated Base, the empty hauling units were not allowed to drive over the edges of the Asphalt Treated Base onto the adjacent shoulder to depart. However, by proper positioning of the hauling units awaiting

to unload in each lane and by balancing the plant production closely to the capacity of the two laydown machines, a workable solution was found to this problem.

Another interesting feature on the Interstate work was the use of newly designed automatic leveling control system to hold grade, crown, and slope of the Asphalt Treated Base being placed. The automatic leveling device consisted of an electronic controlled grid plate which was attached to the laydown machine screed that would reproduce any given datum plane. The datum plane employed was the string line used for alignment. Only partial success was obtained with this method due to the inability to completely eliminate the sag in the string line. A flat plate or runner attachment could also be used in lieu of the grid plate on the same device.

The runner attachment was used to advantage when the laydown machines worked in tandem. The lead laydown machine would level by use of a stringline crew working in advance of the finisher, which was manually controlled. The trailing finisher, with the runner-type automatic leveler attachment traveling on the uncompacted Asphalt Treated Base laid by the lead machine, would make a near perfect hot longitudinal joint and would accurately reproduce the leveling done by the lead laydown machine.

The electronically operated, automatic leveling device did prove it had great potential as a tool to obtain exceptionally smooth Asphalt surfaces with a minimum of effort. Once the problem is solved of providing an acceptable datum plane or stringline from which the grid or runner plate can operate on, this will truly be an extremely accurate tool.

The rolling procedures used on both projects conformed to accepted methods utilized on Type "A" and Type "B" Asphaltic Concrete. Steel-tired rollers producing not less than 250 pounds per inch width were used for the initial and finish rolling. An intermediate pneumatic-tired roller with 90 pounds of tire pressure was also used in the rolling operation.

The only deviation from this rolling procedure occurred while placing the first two (2) inch lift of Asphalt Treated Base on the Interstate project. During this operation the finish rolling was not needed on the Asphalt Treated Base and was used to test roll for soft areas in the subgrade in advance of the laydown machine. This roller also would iron out depressions in the subgrade caused by the hauling units backing into and departing from the laydown machine.

Due to the softness of the asphalt used in the Asphalt Treated Base, it was quickly determined the rolling operation be held back of the laydown machine for a considerable distance when working with only one laydown machine. Even when utilizing two laydown machines in tandem on the Interstate work, only one set of three rollers was required to accomplish the necessary rolling.

Also, on many of the warmer days density of the Asphalt Treated Base was obtained without full ballast in the initial and finish steel-tired rollers. On many occasions when laying the first two (2) inch course on the Interstate work, full ballast of the initial roller was not feasible due to the fears of the Asphalt Treated Base being rolled into the subgrade in the areas of unstable soil beneath the subgrade.

The Engineers in charge of the projects did order tacking of the Asphalt Treated Base between courses to insure bonding of the layers.

Density of the Asphalt Treated Base per layer was determined by the Highway Commission's standard test for Asphaltic Concrete. This method employs the use of a 4" x 4" cut sample taken each day, which is weighed in a liquid for specific gravity determination.

As subsistence of the Asphalt Treated Base into the subgrade did happen on occasion, coring for depth determination was done on the eight (8) inch or the eleven (11) inch lifts. The results of the coring confirmed the actual total depth placed was uniformly close to the intended depth.

The Interstate project has a full fourteen (14) inches of Asphalt Treated Base incorporated into the work on the main lanes of paving. Yet to be done, is the placing of the final two (2) inches of Asphalt Treated Base on the main lanes, plus the four and one-half (4 1/2) inches of Type "A" Asphaltic Concrete on these lanes. Also the items of -- earth shoulder fill, the eight (8) inches of Asphalt Treated Base shoulders, and the shoulder Bituminous Armour Coat must be done. All interchange ramp and grade separation construction must yet be completed. The Highway Commission considers this project approximately 40% complete.

CONCLUSION

In conclusion, the past few minutes have been spent outlining the construction procedures used for Asphalt Treated Base construction on the two projects mentioned previously. Also, it is hoped those of you concerned or interested in Asphalt Treated Base construction have been alerted to the numerous problems involved in this new aspect of highway construction. The construction procedure utilized to date by no means represents a criteria of construction, but should serve as a basis from which further improvements can and should be evolved.

The Asphalt Treated Base provides one very important function sometimes lacking in many of our Rolled Stone Base materials. A high percentage of Rolled Stone Bases soon become saturated with water due to the subsoil capillary action and traffic pumping. Of course, under these circumstances the Rolled Stone Base material loses strength. The Asphalt Treated Base does provide an impervious material with excellent strength characteristics. These strength characteristics allow the designer to decrease the thickness considerably from that which would be required if Rolled Stone Base were used on Primary and Interstate projects.

Therefore, the Asphalt Treated Base gives us a superior base material which, on the projects let to date, is competitive to all types of pavements.