

# HIGHWAY RESEARCH CIRCULAR

Number 64

Subject Classification: Maintenance General  
Bituminous Materials and Mixes

May 1967

COMMITTEE ACTIVITY  
Committee on Maintenance of Bituminous Pavements  
Department of Maintenance  
Highway Research Board

<u>Bituminous Concrete Surface Treatment in Massachusetts</u>	<u>Page</u>
by Paul W. McHugh, Highway Maintenance Engineer, Massachusetts Department of Public Works . . . . .	1

## SUMMARY

Liquid surface treatment with peastone or sand cover used in the maintenance of Massachusetts highways in the late 1950's was considered obsolete. A bituminous concrete surface treatment mixture was designed that could be placed in a thin (3/8-in.) layer over the existing pavement and would also carry vehicular traffic immediately after back-rolling.

Procedures necessary to manufacture and place the bituminous concrete surface treatment mixture at a competitive cost with the liquid surface treatment were developed using all available data for the varied conditions existing in Massachusetts.

The material was placed on various types of pavement surfaces. The process was first used experimentally in 1959, was systematically inspected, and its use was extended annually because failures did not occur.

A study has been made of the costs of all bituminous concrete surface treatment projects that have been completed to date. An average price of \$ 0.25/sq.yd. based on the cost of more than 5 million sq. yd. which represents about 770 lane miles, is favorable in relation to the cost of the liquid surface treatment projects. The bituminous concrete surface treatment mixture has now replaced the liquid application with peastone or sand cover for surface treatment in the physical maintenance of state highways in Massachusetts.

The opinions and conclusions expressed in this publication are those of the author and not necessarily those of the Highway Research Board.

**HIGHWAY RESEARCH BOARD**

**NATIONAL RESEARCH COUNCIL    NATIONAL ACADEMY OF SCIENCES - NATIONAL ACADEMY OF ENGINEERING  
2101 CONSTITUTION AVENUE, N.W.    WASHINGTON, D.C. 20418**

DEPARTMENT OF MAINTENANCE\*

H.J. Rathfoot, Chairman  
Chief Maintenance Engineer  
Michigan Department of State Highways

J.P. Murphy, Vice Chairman  
Deputy State Highway Engineer  
California Division of Highways

COMMITTEE ON MAINTENANCE OF BITUMINOUS PAVEMENTS

W.L. Hindermann, Chairman  
Managing Engineer  
The Asphalt Institute

Members:

Ara Arman, Professor, Louisiana State University, Baton Rouge, La.  
Harold E. Bessey, Bituminous Materials Engineer, Maine State Highway  
Commission, Augusta, Maine  
W.S.G. Britton, Director of Programming and Planning, Virginia De-  
partment of Highways, Richmond, Virginia  
Harry R. Cedergren, 5245 Eye Street, Sacramento, California  
Leslie B. Crowley, Senior Consultant, Directorate of Civil Engineering,  
U.S. Air Force, Washington, D.C.  
William L. Eager, Regional Materials Engineer, Bureau of Public Roads,  
Denver Federal Center, Denver, Colorado  
Charles R. Foster, Coordinator of Research, National Asphalt Pavement  
Association, Texas A & M University, College Station, Texas  
H.W. Gehr, Assistant Chief Engineer, Bureau of Maintenance, Pennsylvania  
Department of Highways, Harrisburg, Pennsylvania  
John L. Haller, Assistant Supervising Engineer, Bureau of Structures and  
Materials, New Jersey Department of Transportation, Trenton, N.J.  
J.A. Hester, Assistant Tests Engineer, Alabama State Highway Department,  
Montgomery, Alabama  
David C. Mahone, Highway Research Engineer, Virginia Council of Highway  
Investigation and Research, Charlottesville, Virginia  
R.A. Scott, Maintenance Engineer, Saskatchewan Department of Highways and  
Transportation, Regina, Saskatchewan  
R.K. Williams, Jr., Executive Director, Virginia Asphalt Association, Inc.,  
Richmond, Virginia

\* As of January 31, 1967

## BITUMINOUS CONCRETE SURFACE TREATMENT

### IN MASSACHUSETTS

#### INTRODUCTION

The purpose of this report is to present the Massachusetts Department of Public Works development program and experience with Bituminous Concrete Surface Treatment.

The aim of the original program was to develop a bituminous concrete mixture with acceptable construction methods that would achieve the benefits of the liquid surface treatment, minimize the deficiencies and yet be as economical.

Bituminous Concrete Surface Treatment as used in Massachusetts consists of a thin (3/8 inch) layer of Class I Dense Bituminous Concrete Type Surface Treatment applied and compacted over an existing road surface.

#### BENEFITS AND DEFICIENCIES OF LIQUID SURFACE TREATMENTS

The problem facing the Maintenance Section of the Massachusetts Department of Public Works in the late 1950's was the fact that liquid treatments with pea stone or sand cover were not completely successful on surface treatment projects. Increased volume of traffic necessitated the allowance of motor vehicles on the newly treated surface sooner than the optimum period of curing. The increased traffic volume caused the friction of the tires to loosen the stones and to windrow them in the gutter. This action along with excess stone coverage was resulting in many complaints from the motoring public of damage to vehicle windshields, paint chipping and asphalt spotting of the car paint.

The changeable New England weather caused many failures when rain fell on the newly treated surface within twenty-four hours after the application of the bitumen. In the fall of the year another difficulty was leaves falling on the treated surface before the stone cover could be applied. During the early spring and late fall, it was necessary to curtail the working hours during which time the bitumen was applied when the air temperature would drop too low for application.

Other general reasons for failures, although not as often as the previous, were the result of the bitumen "setting up" before the application of the stone, the stone being applied too far ahead of the roller, excessive stone cover, dirty stone and other minor reasons.

Liquid surface treatment, in itself, did not contribute to the removal of any depressions in existing road surfaces.

The inconvenience to vehicular and pedestrian traffic was becoming increasingly burdensome. The tracking of the bitumen by vehicles damaged the liquid surface treatment and tracked the material for many miles. The tracking of the material by pedestrians into homes and buildings where it damaged floors and rugs was very offensive to our good neighbors, the abutters. Vehicle delays while the asphalt cured, was not only causing great irritation to the motorist, but was a

factor contributing to rising road user costs.

The principle benefits of a surface treatment are (1) to seal the road surface and reduce roof leakage thus maintaining a more stable subgrade and (2) to rejuvenate the existing road surface, thus extending the life of the highway.

#### DEVELOPMENT OF BITUMINOUS CONCRETE SURFACE TREATMENT MIXTURE

The Massachusetts Department of Public Works had been interested in developing a new type of surface treatment which would eliminate the failures and delays inherent in liquid treatments and which could be applied with no increase in cost.

Several State Highway Departments and Authorities had been experimenting with various bituminous mixes which included some larger aggregate and silica sand mixes, for the purpose of superseding their liquid bituminous surface treatments. Our Research and Materials Division, after investigating these various mixtures, provided the Highway Maintenance Section with a specification for a bituminous mixture which could be applied as a thin layer for surface treatment work.

There are approximately 55 plants in the Commonwealth of Massachusetts producing Bituminous Concrete Type I-1, the material normally used for the construction of highway road surfaces. In designing a material to replace the liquid asphalt treatment, it was considered important that the material be produced using existing facilities without appreciable changes. The Bituminous Concrete Surface Treatment mixture, as designed, can be manufactured using the existing facilities of the various plants with but minor revisions. The surface treatment material, as designed, also has been added to the Composition limits in the Department Specifications requiring no additional sieve sizes or special bins than those already required for Bituminous Concrete Pavement Type I-1 material which has been in use for many years.

The Commonwealth of Massachusetts Department of Public Works Standard Specifications for Highways and Bridges pertaining to Class I - Dense Bituminous Concrete Type Surface Treatment consists of mineral aggregate with 100 percent passing the 3/8 inch sieve, mineral filler and 7 to 8 percent of type O-A-3 asphalt. A detailed specification is in the appendix.

#### SPECIAL PROVISIONS

Along with the Department's desire to keep the Bituminous Concrete Surface Treatment within the limits of the Department Specifications, it has also been attempted to minimize the Special Provisions by using the same methods of placing mix as stated in the standard specifications.

The current contract Special Provisions contain only three general additions as follows:

1. A small amount of material will be spread by hand.
2. The price per ton shall include all necessary cleaning of the existing surface as specified under Section B-18 of the Standard Specifications and shall also include furnishing and applying a fog coat of RS-1 asphalt emulsion at the rate of 1/20th of a gallon per square yard, as directed by the Engineer, immediately prior to placing the Bituminous Concrete Surface Treatment mix.

3. Prior to the Bituminous Concrete Surface Treatment operation, surface repairs shall be made with Bituminous Concrete Type I-1 standard top course gradation. The surface repairs shall be applied in a manner to produce a smooth riding profile as directed (disregarding any specific rate of crown) and shall be applied with a grader, trac paver, or similar machine satisfactory to the Engineer.

#### ADVERTISING AND CONTRACT INFORMATION

Three contracts totalling \$23,700 were advertised and awarded in 1959, the first year of use. Presently the Department advertises for approximately \$400,000 worth of surface treatment annually which is distributed among more than twenty (20) contracts.

An approved list of all highways to be surface treated each year is established. The list of projects is then assembled in groups that are geographically suited for contract advertisement. The contracts contain one or more highways within a District, and the tonnage and costs are estimated for each project.

The Maintenance Section combines these contracts in one Multi-Proposal Book for advertising on one date. This Book contains a set of proposal pages for each contract but requires only one set of Special Provisions and unification of other contract data. The uniform Statewide performance required on this type of work is obtained using this procedure. Much of the redundant paper work and duplication of effort in processing of forms is eliminated by this type of multi-contract format. The Department has received many favorable comments on the use of this type Multi-Proposal Book from contractors who bid on these projects. Each contractor indicates in a specified location on the outside of the book, all projects on which he is bidding. The opening of all bids takes place on the same day.

#### ADDITIONAL ADVERTISING AND CONTRACT INFORMATION

In Massachusetts funds for surface treatment must be spent within the fiscal year for which they were appropriated. It is, therefore, imperative that contracts be awarded as early as possible in a fiscal year in order that work will be completed before the funds expire. We have found, through experience, lower bids are received when a contractor is given ample time to complete the work. Therefore, the Department attempts to award the contracts as early in July as possible using the following June 30th, the end of that fiscal year, as a completion date.

An analysis has been made of the types of contractors who have bid on this work and we find they fall into three general groups as follows:

- A - Mix manufacturers who deliver and place the material with their own men and equipment.
- B - Mix manufacturers who sublet the delivery and placing of the mix to other contractors.
- C - Prime contractors that deliver and place the mix which they have purchased from a mix manufacturer.

## PROCEDURES FOR PLACING BITUMINOUS CONCRETE SURFACE TREATMENT

The surface of the existing roadway is first cleaned of all dirt and debris. The Engineer investigates and marks all depressions, wheel ruts and other surface deformities before the contractor makes the necessary surface repairs. Surface repairs are made well in advance of application of the surface treatment work in order that the patches have sufficient time to cure and be compacted. The method of placing the Bituminous Concrete Type I-1 for surface repairs will generally vary with the type of repairs necessary. A bituminous concrete spreader, with the tamping bar disconnected, a power grader, a drag, or a tow behind the spreader have been used to spread the material for the surface repairs. The material is then properly rolled. This process is repeated, if necessary, to completely eliminate the depressions. It is not necessary to adjust catch basin and manhole frames and grates that conform to a grade which will only be raised by the thickness of the bituminous concrete surface treatment mix. The structures necessary to be raised are adjusted subsequent to surface repairs. Cutting of joints where the new surface treatment meets the existing surface is not necessary as the bituminous concrete surface treatment mix can be feathered. The shape of the road when repairs are completed should be such that a good riding profile results.

Prior to the placement of the bituminous concrete surface treatment mix, a fog coat of liquid asphalt is applied uniformly to the existing pavement, not exceeding 1/20th of a gallon per square yard in quantity.

The bituminous concrete surface treatment mix is transported to the project in vehicles with the same requirements as for transporting of all other bituminous concrete mixtures in accordance with the Department Specifications.

Every effort is made to prevent longitudinal joint failure by aligning the original spreader pass so that the subsequent pass of the paving machine will follow a straight line and lap the entire length along the longitudinal joint. Experienced men must be employed to handle the compensating screws of the spreader to maintain the thickness of the mixture.

The Bituminous Concrete Surface Treatment material is spread with a mechanical, self powered paver, that is capable of spreading and finishing the mixture in a uniform layer as required.

The rolling is attained by steel wheel tandem power rollers, weighing not less than 240 pounds per inch width of tread. The rolling shall commence as soon as possible after the hot mix is applied, as at a depth of only 3/8 inch the cooling process is very rapid. Necessary backrolling may be completed with either tandem power roller or a comparable pneumatic tire roller.

Traffic, generally, is not detoured and is allowed to drive on the completed lane as soon as the rolling operation is complete. It has been found that the Bituminous Concrete Surface Treatment will not track or pick up under traffic.

## BITUMINOUS CONCRETE SURFACE TREATMENT AS APPLIED TO VARIOUS SURFACES

At the commencement of this program the Commonwealth's State Highway System

contained the following general type surfaces that would normally require surface treatment:

- A - High Type Bituminous Concrete Pavement
- B - Bituminous Macadam Pavement
- C - Portland Cement Concrete Pavement (both plain and reinforced)
- D - Bituminous Surface treated gravel or Bituminous Road mix surfaces

Following is a synopsis of Department experience on each type of surface:

A - HIGH TYPE BITUMINOUS CONCRETE PAVEMENT

Bituminous concrete roadways were considered to be especially suited for Bituminous Concrete Surface Treatment as the material used was basically identical.

The section of roadway originally selected to receive a bituminous concrete surface treatment had the necessary requisites for a surface requiring a liquid surface treatment. The initial signs of cracking and map cracking, the weathering of the pavement and signs of severe fatigue to an extent that a surface treatment was required but not as advanced to consider a complete resurfacing. The preparatory work and the bituminous concrete surface treatment were applied to the existing roadway.

The yield of the mix in place on this type of surface was as designed. The new surface fulfilled the necessary essentials of sealing the old surface to prevent roof leakage, yet presenting a new surface that had all the visual qualities of a complete resurfacing.

B - BITUMINOUS MACADAM PAVEMENT

Bituminous Macadam Roadways that were surface treated required the same preparatory work as for a liquid surface treatment. All ravelled areas were repaired in conjunction with surface repairs. After preparatory work, the Bituminous Concrete Surface Treatment was placed on the existing roadway.

It was found that on a "tight" texture surface, the yield for the surface treatment mix was as designed. However, if the existing road had an open texture a higher yield occurred as it was necessary to fill these excess voids. The yield, nevertheless, amounted to an average total depth of less than one half inch.

The results of the Bituminous Concrete Surface Treatment over bituminous macadam roadway fulfilled the necessary essentials of a surface treatment while presenting the new texture appearance of a bituminous concrete resurfacing.

Semi-annual inspections made on many projects to date have shown no raveling on any bituminous macadam highway that has been surface treated with this mix. The rumbling noise and rough sensations that the old surface gave to the travelling public, which was the source of complaints, has been eliminated.

The smooth riding bituminous concrete surface treatment that has been attained on the old bituminous macadam surface has proven to be most pleasing and successful.

### C - PORTLAND CEMENT CONCRETE PAVEMENT

The surface treatment of cement concrete pavement has been done on rare instances.

The cement concrete highways to be surface treated were in very good structural condition with some spalling and surface scaling. The surface repairs were made prior to the placement of the mix. The required yield was easily attained on this type of surface. We have had good results on the few cement concrete roads that were surface treated with bituminous concrete surface treatment mix.

### D - BITUMINOUS SURFACE TREATED AND BITUMINOUS ROAD MIX SURFACES

The remaining roads in the State Highway System fall in this general category. This type of surface is the old gravel roadways built up with cumulative bitumen treatments with stone or sand cover, or mixed in place with a bituminous material.

Originally this type surface was not considered in the bituminous concrete surface treatment program. Many of these road mix surfaces would deteriorate and break up in approximately two years due to poor foundation material, especially weak when wet, necessitating a honing treatment at \$0.18<sup>±</sup> per square yard. It was felt that if Bituminous Concrete Surface Treatment was applied to this type of road surface, that break ups would continue to develop and the maintenance costs would increase at a rapid rate.

Bituminous concrete surface treatment was placed upon certain sections on an experimental basis.

Standard methods were used for application of bituminous concrete surface repairs and surface treatment.

The follow up inspections of these roads shows as good if not better results than the prior three (A, B and C). As the existing surface, sub-base and sub-grade material on these highways did not, originally, meet the high standard required of the first three, the conclusion has been that the tight surface has prevented roof-leakage, increased the rate of water run-off and prevented additional break up due to frost action. These results have led the Department to increase the selection of this category road surface for bituminous concrete surface treatment.

### EXPERIMENT WITH POLYMER ADDITIVE

In 1960, Bituminous Concrete Surface Treatment mix was placed in control sections adjacent to sections containing a Polymer additive. These test sections were placed by the Department following a condition survey made by the Massachusetts Institute of Technology in conjunction with our Research and Materials Section. The various Bituminous Concrete Manufacturers, Asphalt Suppliers and Polymer Manufacturers also cooperated in this experiment.

The material consisted of (1) Bituminous Concrete Surface Treatment mix and (2) Bituminous Concrete Surface Treatment Mix with a Polymer additive. These were placed in various sections in two arrangements as follows:

1 - Sections that were full width of the roadway, one section of Bituminous Concrete Surface Treatment and an adjacent section of equal length of Bituminous Concrete Surface Treatment mix with the Polymer added.

2 - Sections that were half width of the roadway, one section of Bituminous Concrete Surface Treatment Mix and an adjacent section of Bituminous Concrete Surface Treatment mix with Polymer added - both sections within the same length of the highway. The Polymer Additive was blended with the liquid asphalt used in the manufacture of the Bituminous Concrete Surface Treatment mix in quantities regulated by the Department's Research and Materials Section. The materials were placed, using standard methods, under the strictest controls possible.

Observation of the various sections indicates that condition wise, both the Control and Polymer Additive sections are on a par. There is no sign of cracking, longitudinal and transverse joints are in excellent condition, the surfaces have a smooth and even texture with some minor abrasion in the center.

Another field inspection, with representatives of the Department's Research and Materials Section and Maintenance Section is scheduled for this year. The results will be incorporated in the overall study of these tests.

The Department, at this time, does not use a Polymer additive in their Highway Maintenance programs.

#### COST ANALYSIS

The primary objective at the outset of the Department's Bituminous Concrete Surface Treatment Mix Program was to achieve as a minimum the benefits of a liquid bituminous surface treatment with stone cover, eliminate the failures that resulted from some of the factors involved, yet approach the cost of the liquid surface treatment.

A study of the cost of liquid treatments at the commencement of this program revealed the cost to vary from \$0.13 to \$0.18 per square yard depending on the gallons per square yard and the amount of peastone or sand cover used. This cost does not reflect the loss due to failures which occurred on certain liquid treatment projects.

A section of Route 140 in Taunton was selected to place Bituminous Concrete Surface Treatment on an experimental basis in September of 1958. Two other sections, one in Sandisfield (Route 8) and the other in Monson (Route 32) were treated the same year. A close observation was made of the roadways and the results were found to be excellent.

There was a total of 90,687 square yards covered with Bituminous Concrete Surface Treatment at an average cost of \$0.26 per square yard. The cost was higher than anticipated, but considering the experimental nature of the work, it was not considered excessive. For the 1959 Fiscal Year, the Bituminous Concrete Surface Treatment amounted to only 5 1/2% of the total surface treatment program.

In the following year 30% of our surface treatment program was placed under the Bituminous Concrete Surface Treatment method. The results of 519,940 square

yards of treatment were again excellent with the added benefit, a drop in the average cost to \$0.211 per square yard.

Since 1965 the Department has discontinued the liquid bituminous treatment and does all its surface treatment by contract, using Bituminous Concrete Surface Treatment Mix.

From its start in 1959 through the 1965 program, 159,195 tons of Bituminous Concrete Surface Treatment Mix has been used to surface treat 5,432,115 square yards of pavement or about 772 lane miles at an average cost of \$0.205 per square yard or \$1,450 per lane mile. (See Figures 1 and 2 in Appendix)

The 1966 Program is anticipated to add 1,260,000 square yards or 175 lane miles to these totals, a chart showing yearly cost relations is attached in the appendix.

Surface repairs over the same roads, completed prior to the surface treatment, amounted to 49,970 tons of Bituminous Concrete Type I-1 or about \$.07 per square yard. This is an average of about 1/3 the cost of the surface treatment. The actual amount of surface repair mixture needed to produce a smooth riding profile disregarding any specific rate of crown has varied with the existing condition of the highway. It must be assumed that these repairs would have been made under a liquid surface treatment program.

The cost of the Bituminous Concrete Surface Treatment is more economical based on the above. We have had no failures, and as of this writing, no road has required a second application of Bituminous Concrete Surface Treatment Mix.

The liquid surface treatment was applied at a cost which ranged from \$0.13 to \$0.18 per square yard, with a life expectancy of four years. The cost of Bituminous Concrete Surface Treatment amounts to \$0.205 per square yard with an estimated life of seven years (the first highways so treated have now reached the seven year period). Therefore, the cost per year per square yard, for liquid surface treatment, ranges from \$0.035 to \$0.045 against a cost of \$0.029 for Bituminous Concrete Surface Treatment.

The cost relation with regard to highway requiring "honing" is \$0.09 per year per square yard against the \$0.029 for Bituminous Concrete Surface Treatment.

The intangible road user costs that are saved due to a 90% reduction in traffic interference would also add to the savings of the Bituminous Concrete Surface Treatment Mix Program.

#### CONCLUSION

Seven hundred and seventy-two lane miles (or 386 lineal miles of two lanes) of highway with different types of surfaces and varying geographical locations in Massachusetts have been treated with Bituminous Concrete Surface Treatment Mix.

The deficiencies of the liquid surface treatment have been eliminated with the adoption of the Bituminous Concrete Surface Treatment Program.

The benefits derived by the travelling public are fewer and shorter delays, by the adjacent abutters in the elimination of tracking and by the State with a better quality surface for lower yearly costs has served as an economic warrant for the Massachusetts Department of Public Works to expand its use of Bituminous Concrete Surface Treatment to its current status, with a better quality surface for lower yearly costs.

\*\*\*\*\*

REFERENCES

1 - Parker, Burton C.

"The Development of Bituminous Concrete Surface  
Treatment in Massachusetts" April 15, 1963

2 - Commonwealth of Massachusetts - Department of Public Works

Standard Specification for Highways and Bridges

APPENDIX

SPECIFICATION

FOR

CLASS I DENSE BITUMINOUS CONCRETE TYPE SURFACE TREATMENT

General

This type of pavement shall be composed of mineral aggregate, mineral filler and bituminous material.

General Composition of the Mixture

The mineral aggregates, filler and bitumen shall be proportioned and mixed as hereinafter specified to conform with the composition by weight tabulated below. Sufficient approved mineral filler shall be used to correct any deficiencies in grading of fine aggregates.

COMPOSITION LIMITS	MASTER RANGES
<u>Standard Sieves</u>	<u>Percent by Weight Passing Square Opening Sieves</u>
3/8"	100
No. 4	80-95
10	60-75
20	35-60
40	18-40
80	8-20
200	3-6
<hr/>	
Mineral aggregate	
Total for Mix	92-93
Bitumen for Mix	
Percentage	7-8
<hr/>	
Total Mix	100
<hr/>	

Job Mix Formula

The composition limits in the above table are master ranges of tolerances for material in general.

The Engineer shall furnish to the Contractor a specific job mix formula for the particular materials to be used on each project. The job mix formula will specify the single definite percentage for each sieve fraction of aggregate and for the asphalt, as the fixed mean in each instance, the required mixing time. The job mix formula shall bind the contractor to furnish paving mixtures not only within the master ranges, but also conforming to the exact formula thus set up for the project, within allowable tolerances as follows:

Asphalt	± 0.4%
No. 4 and larger sieves	± 7.0%
No. 10 and larger sieves	± 4.0%
Except passing #200 sieve	± 2.0%

Mineral Aggregate

The coarse mineral aggregate shall be considered to be that portion retained on a No. 10 sieve. It shall be clean, crushed rock consisting of the angular fragments obtained by breaking and crushing shattered natural rock, free from thin or elongated pieces, dirt or other objectionable materials. The use of crushed gravel stone will not be permitted. It shall be surface dry and shall have a moisture content of not more than 1/2 per cent after drying.

The coarse aggregate for the top course shall be a uniform blend and if the sources of supply are different, prior written approval of the engineer must be obtained. The rock shall have a percentage of wear as determined by the Los Angeles Abrasion Test (AASHTO Standard Method T 96) of not more than 30.

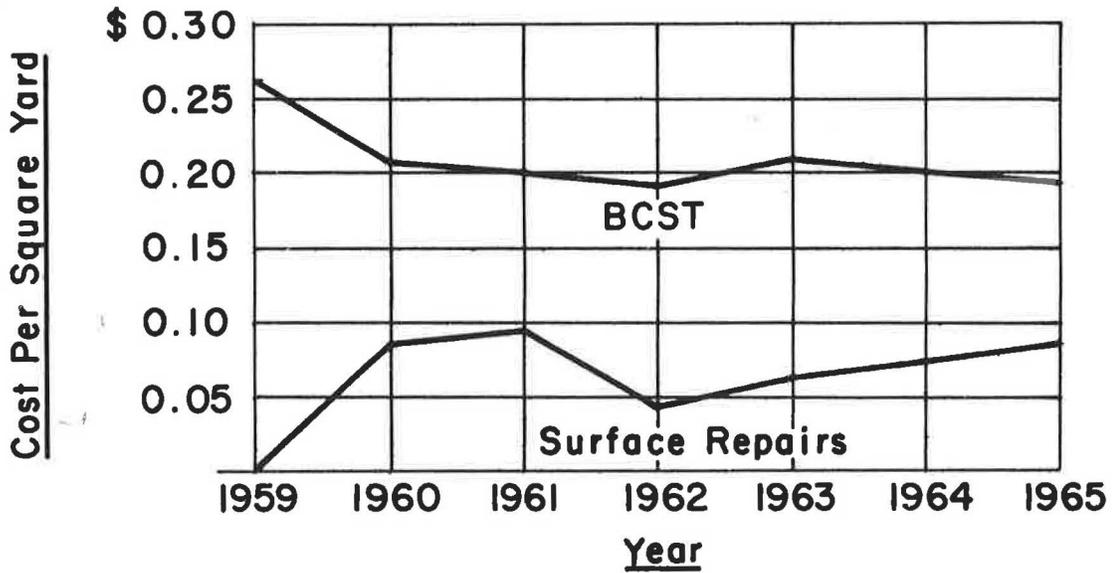
The fine aggregate shall consist of sand or a mixture of sand and stone screenings, of which at least 50 percent shall be sand. The sand shall be prescreened through a 1/2 inch maximum sieve to remove large gravel. Stone screenings shall be free from dirt, clay, organic matter, excess fines or other deleterious materials. Stone screenings shall be the product of secondary crusher or if primary crusher screenings are to be used they shall be reprocessed in a manner satisfactory to the engineer. Primary screenings shall contain not more than 10 percent of the material passing a No. 200 mesh sieve.

Mineral Filler

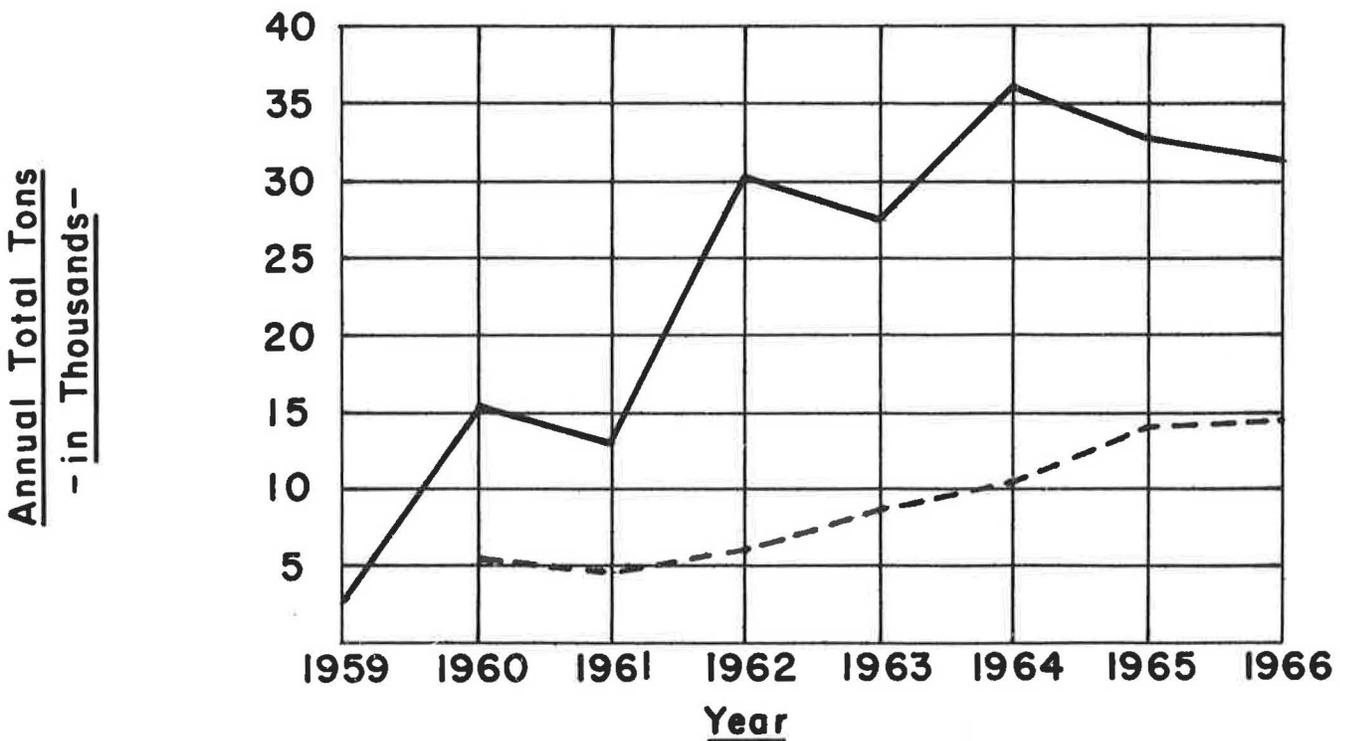
Mineral filler shall consist of approved Portland Cement, limestone dust, hydrated lime or stone dust. Stone dust shall be produced from crushed ledge stone, shall be the product of a secondary crusher so processed as to deliver a product of uniform grading. Mineral filler shall completely pass a No. 40 sieve and at least 65 percent shall pass a No. 200 sieve.

Bituminous Material

A - Mixture      The asphalt cement for the mixture shall conform to the requirements of Designation M-20 of the AASHO for penetration of 85-100 (Department Specification OA-3); as specified by the engineer. When required, an approved anti-stripping compound shall be used.



Annual Average Cost of Bituminous Concrete Surface Treatment and Surface Repairs in Massachusetts



Annual Tonnage of Bituminous Concrete Surface Treatment Mix and Type I-1 for Surface Repairs.  
 ——— Bituminous Concrete Surface Treatment Mix  
 - - - - Type I-1 Top for Surface Repairs