The Asphalt Institute – What It Is and What It Does

A PANEL DISCUSSION

PART 1

REMARKS BY THE PANEL CHAIRMAN, I. W. SANDEN*

The Canadian Engineering & Development Committee of The Asphalt Institute is made up of technical personnel from each Canadian member company.

This Committee, as the name implies, concerns itself with engineering problems and the investigation of ways and means of developing the use of asphalt more effectively and more economically. Only with such a view, and with the objectives of assuring value for every invested dollar, can we consciously gain your confidence and thus expand the use of asphalt.

Canada has its own E & D Committee, as has each of the five (5) Divisions of the United States. Figure 1 attached shows the States covered by each Division. Please note that the Canadian E & D Committee has Canada-wide representation. This brings to you experience from every part of this great country. What does this really mean to you? It means that when we meet twice yearly, or oftener, at the call of the Chairman, we can assemble these experiences, problems and ideas we have gained not only in our own individual company organizations, but also from you. We need and make full use of your experience. Practically every paving job that goes down, whether public or private, is watched by some member of the E & D Committee. After construction its performance is observed—good, fair, or indifferent, something can be learned from each and every project. Certainly anything abnormal or of general interest to the industry is openly discussed at our meetings.

Within the past two years the Canadian E & D Committee has been called upon for recommendations on two large and important projects. One being an asphalt pavement design for an expressway in Eastern Canada, and the other consisting of problem analysis in roadway construction requiring specific scientific recommendations backed by laboratory analysis and data. This expression of confidence and requests for help is very heartening to us. I can assure you it was sincerely appreciated.

To us, it seems that asphalt is blamed for many things that go wrong on an asphalt paving job. This happens, if not every day, then certainly several times each year. The supplier sends out a man from the Technical Services Department, usually your E & D Committee representative. These fellows are loaded with information; not only do they concern themselves with asphalt and its application, but with every component part of a highway, street, or road, as well as construction procedures, techniques, equipment, climatic conditions, drainage, traffic and even the inspectors and engineers.

It is now evident that our task is greatly education. Not only educating ourselves, but passing on everything we learn to you. We have access, by virtue of our Canada-wide coverage, to experience right across Canada. What we have learned is usually passed on to you in the normal course of our duties.

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Figure 1 — The Five Divisions in the United States and Canadian Membership of The Asphalt Institute.

There is another way of gaining experience and education in any field. This is done by concentration of knowledge and experience at an educational institution. I might just mention here that in 1957 Professor Ken Anderson attended an Asphalt Institute - sponsored Seminar at The University of California. He is now teaching a post-graduate course in Highway Engineering, as well as introducing a little more asphalt instruction at the graduate level. For the 1962 Seminar the Engineering & Development Committee in Canada will recommend another Canadian University Professor to attend a similar course, since The Asphalt Institute has recently authorized yearly representation from Canada.

We hope in this way that the young graduate engineers will have a little better understanding of this universally used highway material and will be better qualified for positions in related fields. This, we hope, will help you.

As a matter of fact, The Asphalt Institute objectives as stated in the Constitution are, in all lawful ways—

To advance generally the most efficient use of asphalt through engineering, research and education.

To afford a means for discussion of the various questions arising from time to time of interest to the asphalt industry, and a means for extending and developing asphalt business.

To do all things incidental or conducive to the attainment of the foregoing objects.

Worthy of note is this statement—"The Institute has nothing to do with and no responsibility for production, distribution, pricing, selling, commercial aspects or trade practices pertaining to asphalt materials".

The basic function and historic purpose of The Asphalt Institute is to inform engineers and architects about petroleum asphalt so they will appreciate its advantages and use it with confidence.

In simplified terms, an opportunity to sell asphalt arises when, and only when, an engineer and/or architect decides to specify an asphalt pavement or asphalt roof. For this reason, therefore, we say that petroleum asphalt is sold by engineering or architectural sanction.

To keep abreast of the ever-changing techniques in construction and design practices, a research and development programme is necessary.

In a recent survey conducted by Institute Headquarters, the 49 member companies (at that time) reported that in 1961, nearly 4½ million dollars would be spent on research alone, employing some 250 scientists, engineers and technicians. Since this survey, six additional members have joined the Institute which could put the total expenditure over the five million dollar mark with close to 300 technical people employed in this phase of a refiners operation. These expenditures of money and man-hours do not include the membership dues in the Institute nor the routine testing and product control by the refiner.

Besides these expenditures by member companies, The Asphalt Institute has a research and development programme being carried out at Collge Park. Their present programme follows four (4) distinct but interlocking tracks.

(1) Laboratory research at College Park Headquarters
—has been done on the role of Mineral Filler and Secondary Additives in Pavement Mixes.

(2) They co-ordinate research in Member Company Laboratories
—Typical of co-ordinated work conducted by the Institute Laboratory is the search now under way for an improved asphalt consistency test and related specifications.

(3) Sponsored research at educational institutions
—The University of Washington's unusual linear Test Track and the University of California's research on elastic properties of fine grain soils are but two of the many sponsored research programmes supported by the Institute.

(4) Field work in collaboration with various user agencies
—This is the most recent development but so much interest has been shown that this could be one of the most important.

To show you how this helps you, let us examine the Technical Committee structure.

Some of the Canadian Engineering & Development Committee Members serve on Project Committees. Figure 2 is the functional and administration chart. Notice that the respective E & D Committee Chairmen form the Technical Co-Ordinating Committee. The functions of the T.C.C. are just exactly as the name implies; it co-ordinates the technical activities of the Institute. It is empowered to form the Project Committees, assign tasks, and offer guidance.

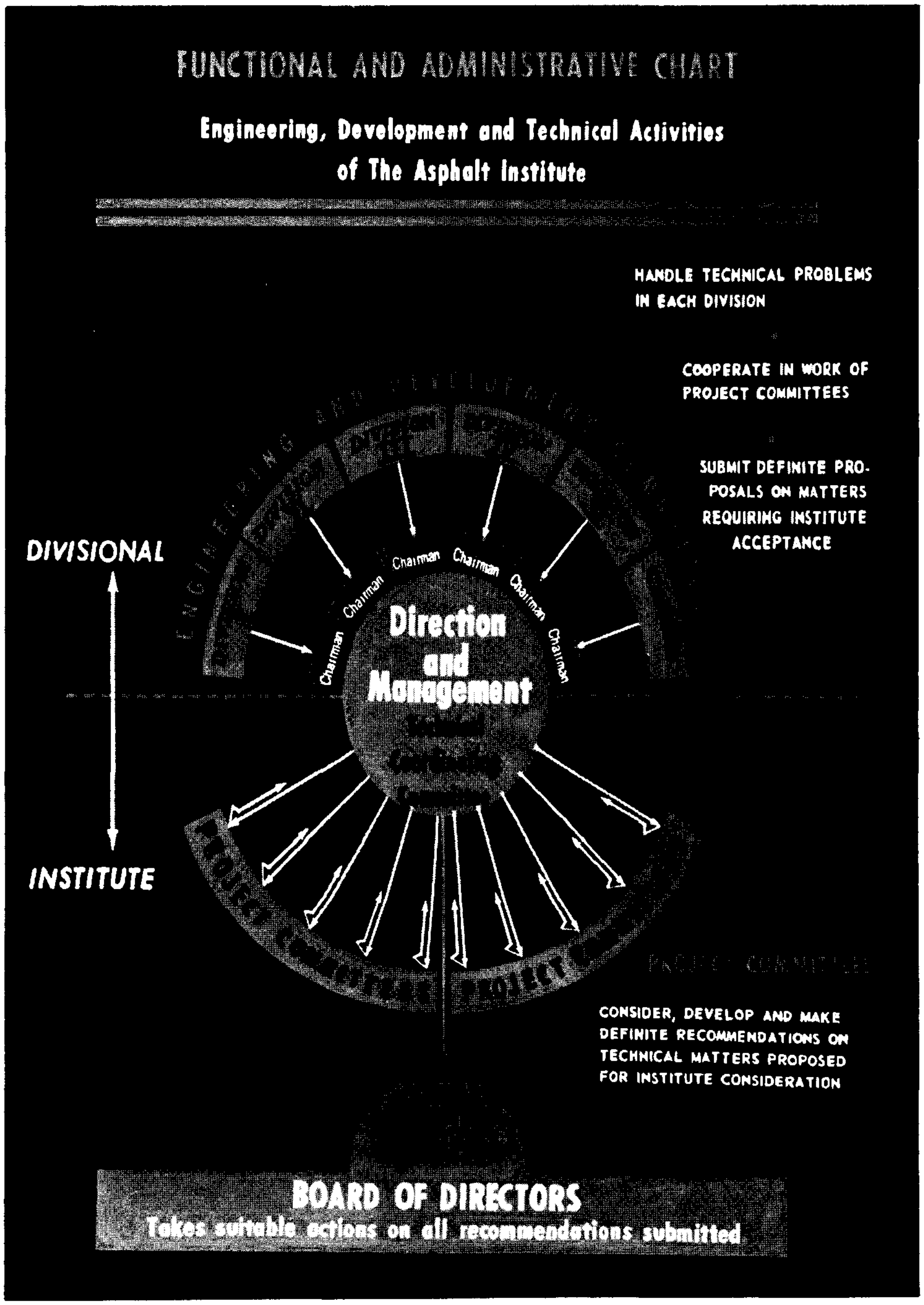

Figure 2

These Project Committees are the Technical Working Committees. Canada has a Primary and an Alternate Representative on each of the present nine (9) Project Committees, as has each of the five (5) Divisions of the United States. Besides a chairman — appointed by the T.C.C., and an Asphalt Institute Staff Recorder—appointed by Institute Headquarters, a Project Committee, therefore, consists of six Primary and six Alternate Members. The Secretary-Recorder acts also as an advisor at the meetings.

From these Project Committees comes the material which goes into printed publications. The Staff Technical Writers at Institute Headquarters edit and review the various chapters prepared by the Project Committee Members. Corrections and alterations are referred back to the Committee before final printing and publication. Here then, at Headquarters, is another central source of knowledge and experience to which we have access.

The men on Institute Headquarters Staff are very capable individuals. They represent the industry on A.S.T.M. and A.A.S.H.O. Committees; work very closely with the U.S. Bureau of Public Roads, the Highway Research Board and hold memberships in the A.A.P.T. and our own organization, the C.T.A.A. Close liaison is also maintained with related organizations such as the National Bituminous Concrete Association.

You can now begin to appreciate the vast reservoir, reserve, and source of knowledge and experience to which we are exposed, from every part of the United States as well as Canada and other foreign countries.

I might just mention a few of the accomplishments of the Institute since its founding in 1919.

(1) Early in the 1920's the number of useful grades of asphalt cement was reduced from 102 to 9. In January, 1957, a further revision was adopted, reducing the number of grades from 9 to 4, with one additional grade for industrial and special uses.

(2) In the late '20's and early '30's the Institute promoted a low cost type of surfaced highway in a "Stage Construction Programme". This led to the development of great transportation industries—so vital to every phase of our economy.

(3) During the same period, the number of Cutback grades was reduced from over 100 to 18. Consideration is being given now to further modifications.

(4) The '30's also saw an increase in the use of asphalt in place of coal tar.

(5) The Institute has helped in the development of better paving equipment, resulting in more economical and rapid construction.

These are but a few of the accomplishments that have taken place during the history of the Institute. This could not have been done without the diligent work of the technologists serving on Project Committees and the co-ordination of this work by Institute Headquarters.

Membership on these Project Committees is made up of some of the top Asphalt Technologists available. I wish I had the time to name them all, and tell you something about each one, but, of course, this is not possible. I don't think it fair to mention just a few because every one of them plays an important and vital role.

I can, however, introduce you to the participating Canadian Technologists, who will tell you about their activities in the Project Committees on which they serve.

PART 2

PROJECT COMMITTEE No. 1

Asphalt Specifications

By H. R. HAWTHORNE*

Project Committee No. 1 writes asphalt specifications based on established test methods such as A.S.T.M. and A.A.S.H.O. qualified procedures. We correlate tests and test limits with field experience and substantiating data. We attempt to set limits and number of grades based upon sound engineering practice.

The Asphalt Institute specifications have been sometimes described as being too broad to define anything but grade. They do in fact, however, provide materials for every engineering need. Designed for world-wide application, they do, of course, comprehend all local conditions but not

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all local practices. Many local problems in the field are frequently related to the use of the wrong grade of asphalt.

During the past few years this Committee has assisted in the preparation and adoption of the existing Asphalt Institute specifications for asphalt paving cements. In brief, the old 9 grades of asphalt cement have been reduced to 4. Canadian practice comprehends only 3 grades, a development that predated the Asphalt Institute action.

The Thin Film Oven Test has been added in place of the old time-worn Loss on Heat Test.

Viscosity at 275°F. has been added as an aid to mixing practices.

The two foregoing tests are the only tests which the Committee has been able to add to the Asphalt Institute Specifications in recent years which appeared to have any relation to field performance.

Project Committee No. 1 has continuously studied and are still studying other tests which have been proposed.

PART 3

PROJECT COMMITTEE No. 2

Asphalt Pavement Construction Specifications

By DR. N. W. McLEOD*

Since membership in The Asphalt Institute consists of petroleum companies that manufacture and market asphalt, it might be expected that the characteristics of asphalt binders of various types would be the principal concern of The Institute.

However, it had become quite evident years before The Asphalt Institute was formed in 1919, that the success or failure of asphalt pavements depended much more on the asphalt pavement design and construction procedures being used, than on the characteristics of the asphalt cement itself. Regardless of the source of the asphalt binder, poor pavement behaviour resulted whenever poor design or construction practice was employed. This is still the case. Around the world as a whole today, the most common cause of poor asphalt pavement performance is not the so-called quality, or characteristics, or the nature of the specifications for the asphalt binder itself. The No. 1 cause of poor pavement behaviour is the failure to adopt and enforce pavement design and construction procedures that utilize asphalt binders correctly.

For more than a quarter of a century, therefore, The Asphalt Institute has been preparing and publishing construction specifications for asphalt surfaces. **It is the principal function of Project Committee No. 2, to keep The Institute's existing asphalt pavement construction specifications up-to-date, and to prepare new construction specifications as required.**

Probably the best known of The Institute's earlier specifications for pavement construction is the old green-covered volume entitled "Construction Specifications". This contained twenty-five different construction specifications for surface treatments, seal coats, mixed-in-place, penetration and mixed macadam, cold plant mixes, and various types of hot-mix ranging from sheet asphalt to asphaltic concrete. Near the end of World War II, the Institute published a "Manual on Hot-mix Asphaltic Concrete Paving". This covered only heavy duty asphalt concrete mixes, and it was compiled for use in post-war highway paving programs.

Both of these earlier publications have been out of print for a number of years.

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In 1957, because of the multiplicity of specifications for hot-mix asphalt pavements, The Asphalt Institute brought out a new publication entitled, "Specifications and Construction Methods for Hot-mix Asphalt Paving". The principal purpose of this new publication was to simplify specifications for hot-mix construction. All hot-mix construction specifications were classified into eight principal groups, ranging from coarse mixed macadam as Group I to fine sheet asphalt as Group VIII.

Project Committee No. 2 is a very active, hard-working, technical committee. During the past two years it has prepared,

1. Specifications and Construction Methods for Plant-mix, Cold-laid Asphalt Pavements.
2. Specifications and Construction Methods for Mixed-in-Place Asphalt Surface and Base Courses.
3. Manual on Asphalt Surface Treatments.

These will be published soon as new construction specifications.

At the present time, Project Committee No. 2 is working on the preparation of,

4. Specifications and Construction Methods for Asphalt Penetration Pavements.
5. Manual on Asphalt Treated Bases.

In addition, Project Committee No. 2 has co-operated with Project Committees 4 and 5 on the preparation of a new Airport Manual, which will be published as soon as editing is complete.

Each of these construction specifications is periodically reviewed by Project Committee No. 2, and is revised if necessary, to include any new developments in mixing equipment, spreaders, rollers, construction techniques, etc. Consequently, the various construction specifications of The Asphalt Institute are probably the most up-to-date that are available anywhere.

As soon as they are published, all of these asphalt pavement construction specifications and manuals are available to anyone who wishes to make use of them.

Some of the asphalt pavement construction specifications in current use in Canada are very much out of date. Occasionally, specifications that are at least thirty years old are still being employed. Better construction specifications would contribute to improved pavement performance.

The Canadian Engineering and Development Committee of The Asphalt Institute would be glad to work with any organization that would like to review and revise its asphalt pavement construction specifications.

PART 4

PROJECT COMMITTEE No. 3

Asphalt Treated Bases

By J. E. D. KERR*

This Committee concerns itself with the utilization in bases of naturally occurring granular soils, and aggregates which would not in their natural state be classified as materials of sufficiently high quality to be used as bases.

Construction of modern highways is expensive and in many areas supplies of high quality granular aggregates are limited, so the use of other locally available granular materials can achieve considerable

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economies. Project Committee No. 3 has studied the problem of elevating the load bearing characteristics of such materials by the use of asphalt, with and without other additives and the results of this study are incorporated in a new Manual, shortly to be issued. This application of asphalt represents such a large potential saving in paving cost in many areas that it is anticipated that this type of base construction will become widely used.

The study of the use of asphalt membranes as capillary cut-offs by the Texas Highway Department has also been undertaken by this Committee as an alternative to treatment of all the base material with asphalt.

The work of this Committee is supported by a laboratory programme to develop procedures for improvement of base materials with asphalt. This constitutes a large proportion of A.I. Laboratory time. The nature of this programme can be learned from the titles of the various aspects which have recently been examined.

"Effect of Delayed Compaction on Properties of Soil-Asphalt-Additive Systems"

"Soil Stabilization with Cracked Road Oils"

"Effect of Secondary Additives"

"Soil Stabilization with Cationic Emulsions"

Recently much of the lab work was summarized in a paper to the Highway Research Board by Pusinauskas & Kallas, of the A.I. staff, entitled "Stabilization of Fine Grained Soils with Cutback Asphalt and Secondary Additives," and a further paper is to be presented at the next meeting in January. The results of the black base work in the A.A.S.H.O. Road Test are being studied with great interest by the Committee, but unforunately comments on this project are not permissible at this time.

Asphalt treated bases are not new and the use of this type of construction is further advanced in Europe than on this continent.

In Germany a long range research program was initiated in 1952. The purpose of the project was to test and evaluate all of the different base types deemed suitable for asphalt surfaces. It was also designed to afford a comparison between two types of bases, long standard for heavy traffic highways in Europe—the Telford base of large hand-placed stones and the portland cement concrete base. However, as the studies progressed the advantages of the combination of black base and heavy duty asphalt surface became strikingly apparent.

The combination of resiliency and "stiffness" offered a wide range of advantages. When compared with a granular base of the same thickness, the asphalt base sharply reduced the traffic stresses imposed on the subgrade. From this it was obvious that asphalt could cut down the thickness requirements not only of the base but of the entire pavement structure.

Another important economic feature of the design was the fact that locally available materials unsuitable for granular bases could be used successfully. Further, it was found neither essential nor even desirable to draw up close gradation limits since these could prove needlessly restrictive in making full use of local materials.

As a result of this programme, the use of asphalt bases in Germany has increased rapidly, particularly in the autobahn, and according to the magazine "Bitumen", West Germany has constructed over 40 million square yards of asphalt base since 1955.

In Italy the Autostrada del Sole—the new highway linking Milan and Naples—has about 100 miles constructed with asphalt base.

Austria, France, Holland and Switzerland have all constructed significant mileages of road using black base.

In asphalt pavement design, too often the design engineer will designate pavement thickness for a given load and given subgrade conditions, without any regard for the special characteristics of the various courses making up the multi-layered structure. In other words, the emphasis is on an arbitrary thickness standard, with no premium allowed for the use of better materials in the design courses. Generally, it might be said this approach is based on requirements to prevent shearing failure within the pavement itself. Since they are based on the various road-building agencies' first-hand experience with the poorest material allowed for the specification, these designs are normally very satisfactory. However, there is a growing awareness that we should be designing asphalt pavements to incorporate strength concepts, not thickness alone.

Engineering design of a structure is primarily a process of balancing load stresses (determined by measurement or theoretical analysis) against the strength of the materials (determined by laboratory tests or by certain factors derived from field measurements). Unfortunately, we are not able to express these in concise mathematical terms based on accepted structural theory. Yet by relying on relationships which are empirical, but still based on good sound engineering calculations, we can effectively establish the structural capabilities of various pavement courses.

The design engineer of today is undoubletdy giving more and more attention to the importance of bases. Some of the factors coming into greater prominence are:

1. Strength or elastic stiffness
2. Fatigue resistance
3. Moisture and/or frost resistance

The first of these has perhaps occupied the most attention. Stiffness is a vital consideration in that deflections of a pavement under wheel loadings should be kept down to avoid resiliency cracking or fatigue cracking in the asphalt concrete surfacing. This quality can be built into a pavement by an increase in thickness, or by using highly cohesive asphalt-treated bases. Actually, a combination of the two methods can be used, depending upon economic considerations. Since we can go only so far in thickness, it seems only logical to use a combination of thickness plus added cohesion in the base course. This calls for a material which has slab strength without brittleness, a requirement met by asphalt concrete or asphalt penetration macadam bases.

In building stiffness into a pavement, however, it should be remembered that resiliency is also an important consideration. The pavement must be able to absorb the load.

The concept of "strength" is difficult to apply equally to all materials. We must consider how each is affected in relation to its position in the pavement structure. In roadways, the important thing is the actual stresses and strains which take place under moving loads. Certainly field experience has shown that thick sections of pavement constructed with poor materials sometimes fail, indicating that thickness is not the answer.

Laboratory testing by the Asphalt Institute, Great Britain's Road Research Laboratory, the University of Washington and the Kansas Highway Department all confirm that asphalt treatment of bases increases the strength markedly, and road tests with the Shell Dynamic Tester confirm these findings. Experience on the WASHO Test Road adds further evidence.

The New Jersey Turnpike proves conclusively that deep strength asphalt can carry the heaviest traffic over most difficult subgrade without undue strain.

SUMMARY OF ADVANTAGES OF ASPHALT BASES

In summary, it can be said that asphalt bases offer at least eight basic advantages in highway construction.

1. They lower stresses on subgrade, and permit reduction of total pavement thickness.

2. They make many low-quality aggregates usable.
3. Its use minimizes construction delays by protecting the sub-base and/or subgrade from rain, and by providing a sound roadbed for construction haul traffic.
4. They provide ease and uniformity of compaction which prevents wheel-track rutting.
5. They do not require recompaction after rains as do many untreated bases.
6. Asphalt bases are moisture and frost resistant.
7. They add uniformity to the pavement, which definitely improves the riding qualities of the final surface.
8. Asphalt bases allow stage construction, which provides greater traffic utilization and ensures added durability and smoothness because new grades are given time to settle and stabilize.

PART 5

PROJECT COMMITTEE No. 4

By E. T. HIGNELL*

Since the Asphalt Institute is, by definition, an international, non-profit association to promote the use of asphalt through programs of engineering, research and education, it follows that one of the working groups from the engineering side should concern itself with the development of structural designs for highways. This group within the Asphalt Institute is known as Project Committee No. 4, and is responsible for the preparation and publication of the Asphalt Institute's Manual Series No. 1 which deals with the design of a pavement. Quoting from the introduction to this Manual, we find that it states "An asphalt pavement structure may be designed to support any traffic density and axle load. It does so by distributing, downward and outward, the high intensity stresses imposed by a loaded wheel, reducing these stresses in magnitude until they may be safely carried by the native or subgrade soil."

"The wide range of construction combinations made possible by the use of asphalt pavement structures permits an economic design for all conditions of traffic and loading."

It is then, as can be seen, the responsibility of Project Committee No. 4 to collect precise engineering data which will be publishable by an organization of the size and stature, if you like, of the Asphalt Institute, without equivication, for use throughout any part of the world. This booklet has, as many others, been translated into many foreign languages and is used very widely.

It can, therefore, be depended upon by anyone who is seeking information for their own use in the design of pavement structures. It should be recognized, of course, that large organizations such as the highway departments of various provinces or states, may have and, in fact, do have their own design, but it should also be recognized that the Asphalt Institute, in publishing this booklet, will have taken into account the best thinking of these organizations and all other organizations for whom the publication of a specification is of primary importance. What we are trying to illustrate here is, I think, the fact that this booklet is the compilation of the best thinking not only of members of the engineering staff of various companies in the Asphalt Institute and the Asphalt Institute's own engineers,

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but is a compilation also of the best thinking of such organizations as The Highway Research Board, AASHO, The Corps of Engineers, and The Canadian Department of Transport. Not only has there been this compilation, but also there has been a very close co-operation between The Asphalt Institute, The Highway Research Board and the Bureau of Public Roads going back many years. Historically, one of the very early test roads at Hybla Valley, in 1944, was designed on the basis of the engineering knowledge available to these three organizations at that time. The design criteria which formed the basis of the design curves in The Asphalt Institute's booklet grew out of this early work. One of the continuing functions of the committee is to study and evaluate the current data as it appears, such that The Asphalt Institute design is kept up to date. This policy has resulted in a new edition almost yearly in recent times. You should appreciate that the committee is faced with a decision as to the desirability of publishing the information versus the possibility that the reader might get the erroneous impression that these numerous additions are the result of indecision on the part of the committee. Such, of course, is not the case.

A major revision is just commencing which will bring into this book the scientific and engineering data arising from the one million coverage AASHO Test Road at Ottawa, Illinois. As data is released by The Highway Research Board, it is being made available to a special study group of Asphalt Institute engineers, under the direction of Project Committee No. 4 Chairman Dr. N. W. McLeod.

The analysis of this great volume of data will become the basis of design for all highways well into the future. Your best reference will continue to be this Asphalt Institute book.

I am not going to attempt today to go into any detail as to the contents of the book. In general, however, it can be said that the book contemplates both engineering and economics, for the design of a structure to carry a load must countenance the ability of the various materials to be used to carry their portion of the load and must allow for an economic usage of these materials.

The principal chart of the book is designed to allow one to find the structural design necessary for varying axle loads from 3,000 lbs. to 42,000 lbs., and for different traffic classifications in relation to the bearing value of the different soils which are available for use.

Additionally, one can evaluate economically the desirability of having a wholly aggregate-formed sub-base or, alternately, an asphalt-treated sub-base. Various test roads have shown that one inch of asphalt-treated base, or sub-base, is equal in bearing value to two inches of untreated base. Clearly, when axle loads and traffic classifications are reaching the level that one sees on modern highways, the economies to be achieved by using this method of limiting the structural thickness needed must and should be evaluated.

From basic soil mechanic's tenets, it is logical to assume that this committee must concern itself with compaction. Neither soils nor asphaltic concrete can reach their ultimate bearing value without being properly compacted. The committee has been responsible for compiling that section of the Asphalt Handbook which deals with compaction. Briefly, it has been noted that to achieve the density required in an asphaltic concrete, such that it will not change during the life of the pavement under traffic, it is necessary to densify this asphaltic concrete with a roller of weight and tire pressure equal to or greater than that which will be applied to the pavement during its life. A very great amount of data has been collected on the subject of rolling with the high tire pressure rollers, and the effect this has had on the life of the pavement as a result of preventing the permeation of air and water into the pavement. However, it has been noted repeatedly that one must have a base against which to roll if one is going to get a good job done. Thus, it becomes a logical corollary to the high tire pressure rolling of asphaltic concrete pavements to suggest that the sub-grade and granular base courses should be proof rolled with forty to fifty-ton pneumatic-tired rollers, carrying tire pressures of fifty to ninety pounds per square inch. This will discover yielding or soft spots which can be repaired and made firm before the additional lifts of the embankment or pavement are placed. For those who are unfamiliar with the procedure, proof rolling is rather fully described beginning on Page 151 of The Asphalt Handbook.

While it is likely that the greatest concern of the large portion of the membership in this association is with highway paving, we should not forget that airfield paving is increasing in importance with every passing year of the air age. Many of the problems of structural design are common to both highways and airfield pavement. Some problems created by the width of runways are unique. The Asphalt Institute has, in the final draft stage, a new manual on airfield pavement which should be coming off the presses in the near future. We believe those of you who are concerned with airfield paving will find this a welcome addition to your library.

Returning now to the structural design manual, let me say this— Earlier editions of the book contained references only to methods of determination of Soil Bearing Value. It was found in practice, however, that all too often engineers who wished to use the design curves did not have access to the soil evaluation methods.

Accordingly, the Project Committee has just completed compiling a soil manual to overcome this difficulty. Published in June of this year, the new soils manual has brought together in our handy publications, information on the significance of all of the generally recognized soil classifications, together with detailed methods of procedure for the three principal mechanical methods of determination of soil strength values.

Photographs of standard equipment and dimensional drawings of special equipment are included.

All of these books bearing on structural design should be in the library of anyone who has any need for this kind of information. While they are, frankly, promotional to promote the use of asphalt in pavement structures, they are promotional in the best manner possible, which is the presentation of well authenticated engineering facts.

PART 6

PROJECT COMMITTEE No. 5

The Design of Asphalt Paving Mixtures

By DR. N. W. McLEOD

Project Committee No. 5 of The Asphalt Institute is responsible for methods of design and design criteria for asphalt paving mixtures. These are described in the Institute's publication, "Design Methods for Hot-Mix Asphalt Paving". This manual describes in detail, four different methods that can be used for the design of paving mixtures. These are, the Marshall method, Hveem method, Hubbard-Field method, and Smith Triaxial method.

In addition to describing each of these four methods of paving mixture design, the manual also provides paving mixture design criteria such as stability, voids, etc., that paving mixtures must satisfy when designed by any one of these four methods. For example, for asphaltic concrete for heavy duty traffic, the minimum stability requirement by the Marshall method is 750 pounds, by the Hubbard-Field method is 1200 pounds, and by the Hveem method is a relative stability value of 35.

During the past two years, Project Committee No. 5 has devoted much time and effort on reviewing and revising this publication. The revised edition will be published next spring (1962). It will contain a number of changes representing new developments and new information that have become available since the first edition was published in 1956.

Since the Marshall Test is widely used in Canada for the design of asphalt paving mixtures, the Marshall Test design criteria that will appear in the revised edition of this manual are listed in Table 1, of which Figure 1 is an essential part.

The question might be asked why a highway or municipal organization should adopt paving mixture design criteria such as those shown in Table 1, and incorporate them into its specifications, since their use and enforcement involves the cost of a laboratory and its staff, whether this exists within or outside the organization. What advantages can it expect from this, rather than relying entirely on the good judgment of an experienced asphalt pavement inspector or engineer?

This question can be answered very easily. When paving mixture design is guided only by the judgment of an experienced inspector, it is inevitable that pavements will be constructed that range all the way from those that are flushing or bleeding because they contain too much asphalt, to those that are ravelling and cracked because they contain too little binder. Either of these two major defects seriously reduces the useful life of an asphalt pavement.

The many years of excellent pavement performance that would be possible in most cases, if the same aggregate and asphalt materials were proportioned properly in accordance with the basic principles of good design, is seldom achieved merely on the basis of personal judgment even when an inspector is highly experienced. Good pavement design requires the guidance of properly conducted laboratory tests.

The cost of poor performance of even a few miles of asphalt pavement in the form of excessive maintenance or of complete replacement, or of the shortened service life of pavements in general, very quickly exceeds the annual cost of an adequately equipped and staffed asphalt pavement laboratory (or of an equivalent amount of testing and inspection by a competent commercial testing laboratory).

On the other hand, it cannot be emphasized too strongly, that unless the laboratory personnel are **thoroughly acquainted** with the basic principles of good paving mixture design, they can make very serious mistakes. Through misunderstanding of the significance of the basic principles of good paving mixture design, it is possible for laboratory designed paving mixtures to provide worse service performance than the poorest pavements resulting from designs based entirely on the good judgment and visual inspection of an experienced asphalt pavement inspector or engineer.

One of the most serious errors in asphalt paving mixture design that has been repeated over and over again by newly formed asphalt pavement laboratories (and by some not so new), during the past thirty years, is designing for high stability and giving little or no attention to pavement durability. Pavement stability seems to often have a fascination for laboratory personnel, and they become imbued with a conviction that the higher the stability the better. The resulting asphalt pavements have invariably been seriously underasphalted, and they have usually begun to crack badly, and many of them have started to ravel seriously sometimes within a few months after construction. A well-designed asphalt paving mixture requires proper balance between stability and durability. When it has been correctly designed, using good aggregate materials, and properly constructed, an asphaltic concrete pavement laid on an adequate base should have a service life of from 20 to 25 years, even when carrying very high traffic volumes.

The Asphalt Institute has an asphalt pavement research laboratory at its headquarters on the campus of the University of Maryland at College Park near Washington, D.C. Project Committee No. 5 works very closely with this research laboratory, where several projects of pavement research are currently under way. These include investigation of the different variables of pavement design including nature and blending of aggregates, use of mineral fillers, more effective methods for compacting paving mixtures in the laboratory, stabilization of soil with asphalt, etc.

As in the case of pavement construction specifications, the Canadian Engineering and Development Committee of The Asphalt Institute would be glad to work with any organization that would like to review and revise its criteria for asphalt paving mixture design.

TABLE 1

MARSHALL DESIGN CRITERIA

Traffic Category	Heavy and Very Heavy		Medium		Light	
No. of Compaction Blows Each End of Specimen	75		50		35	
Test Property	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
Stability, all mixtures	750	—	500	—	500	—
Flow, all mixtures	8	16	8	18	8	20
% Air Voids						
Surfacing or Leveling	3	5	3	5	3	5
Sand or Stone Sheet	3	5	3	5	3	5
Sand Asphalt	5	8	5	8	5	8
Binder or Base	3	8	3	8	3	8
% Voids in Mineral Aggregate						
	See Fig.		See Fig.		See Fig.	
Surfacing or Leveling	I	—	I	—	I	—
Sand or Stone Sheet	"	—	"	—	"	—
Sand Asphalt	"	—	"	—	"	—
Binder or Base	"	—	"	—	"	—

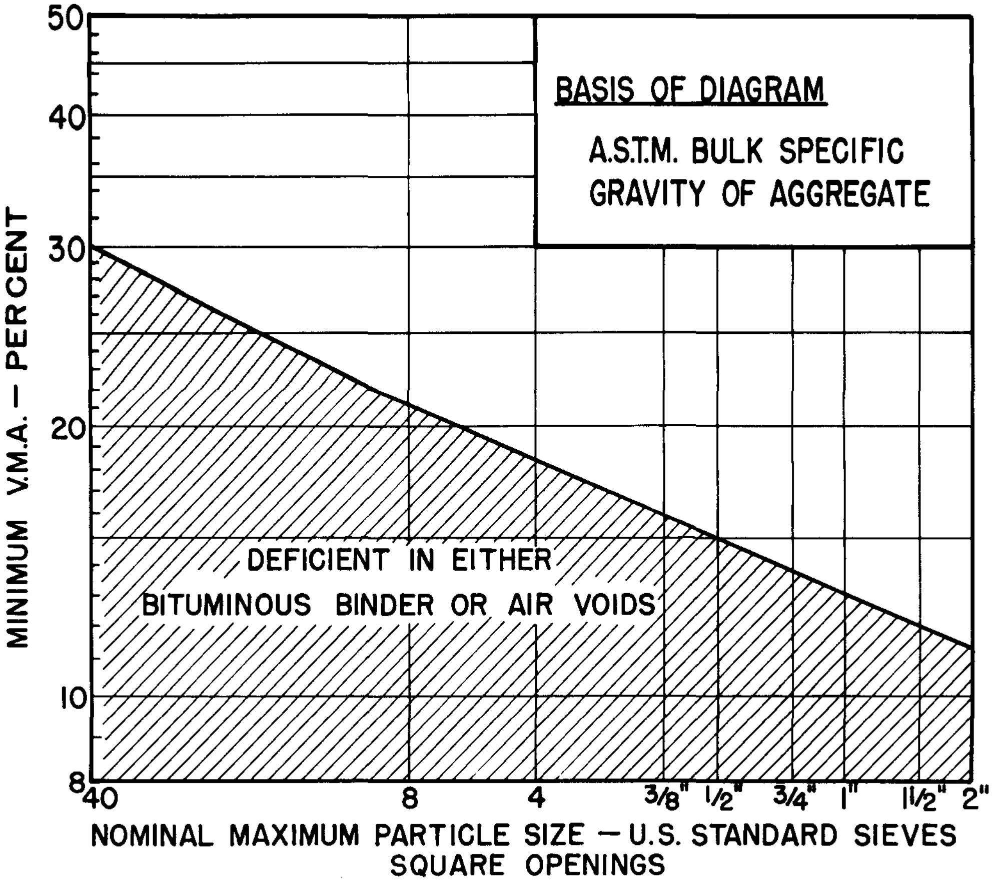

FIGURE 1 RELATIONSHIP BETWEEN MINIMUM V.M.A. AND NOMINAL MAXIMUM PARTICLE SIZE OF THE AGGREGATE FOR COMPACTED DENSE GRADED PAVING MIXTURES.

PART 7

PROJECT COMMITTEE No. 6

Asphalt In Hydraulic Structures

By J. E. D. KERR

This committee has recently reviewed all available information on the use of asphalt and asphalt mixtures for such purposes as waterproofing dams, lining canals, prevention of erosion of river banks, sea walls, jetties and groins.

Pertinent information has been collected to form a manual which is now in the hands of the printers and will be issued shortly.

Asphalt has been used for hydraulic purposes for quite a long time, but the use has been sporadic and often not well documented, with the result that the use of asphalt for this purpose has not been as widespread as for many other purposes.

It is hoped that the issue of the Manual will help to spread knowledge of this application of asphalt as, in the past, lack of information has resulted in many engineers not even considering the use of asphalt in many locations where it is the most suitable and economical material.

As a further means of spreading information on this application of asphalt, some of The Asphalt Institute Divisions are sponsoring regional conferences and one has already been held in Division V (Western U.S.A.).

Recent activities of Project Committee No. 6 have been the study of the treatment of sewage lagoons with asphalt primer to retard leakage, and the preparation of a specification for asphalt for use as a membrane lining of the hot sprayed type.

PART 8

PROJECT COMMITTEE No. 7

By I. W. SANDEN

This Committee concerns itself with Asphalt for Industrial Applications. It may surprise you to know that asphalt plays a very important role in our every day living.

Roofing is probably the most important use, followed by corrosion protection and miscellaneous adhesives and caulking compounds. You find asphalt in batteries, refrigerators, flooring, tires, electrical insulations, wood preserving, foundation coatings, hoses, conveyor belts, building paper and many, many other items with which we are in contact every day of the year.

Project Committee No. 7 for the past couple of years has been working on material for an Architect's Handbook. The various chapters are being written by members of this Committee with the capable assistance of the Institute Headquarters staff. They are gradually beginning to unfold for final editing and publication.

This book will contain guide specifications for roofing and roofing materials along with information on surfaced roof-deck parking areas, paving of parking areas and streets, and various other phases of design and construction with which an architect may be faced in developing a building and surrounding areas.

This Committee has published our Construction Series No. 96 on Asphalt Protective Coatings for Pipelines. This Series is, of course, similar to other publications, subject to review and revision.

PART 9

PROJECT COMMITTEE No. 9

Properties of Asphalt

By H. R. HAWTHORNE

The assigned responsibility of Project Committee No. 9 was:

(a) To determine what properties of an asphalt are important for predicting its suitability and performance on the road.

(b) To develop and qualify test methods for measuring these properties.

It has developed that this is too much for one Committee to handle. Therefore, the work of evaluating and establishing reproducibility limits of test methods has been recently re-assigned to Project Committee No. 1.

In the recent past, Project Committee No. 9 has studied and evaluated the influence of rubber and anti-stripping additives on the performance of asphalt.

A considerable number of tests have been proposed from time to time by various agencies with which their proponents have hoped to more signicantly control the performance characteristics of asphalts. Some brief remarks relative to some of the tests investigated are in effect a narration of the activities of Project Committee No. 9 in recent times.

Penskey Martin, Closed Cup, flash test. The Committee found that this test would in fact detect small traces of contamination in asphalt cement caused by clingage, etc., in tank cars and trucks—for example, from preceding loads of RC asphalt—which might be overlooked by the Cleveland Open Cup tester. It further developed that if such contamination was so slight that the Cleveland Open Cup test would not report it, no significant effect on consistency developed. The Penskey Martin equipment furthermore presented severe cleaning and maintenance problems and was time consuming. It was, therefore, not adopted.

Thin Film Oven Test was investigated and was found to be no more reproducable than the old Loss on Heating test. There did, however, seem to be some relationship between the loss of penetration in this test and that lost in hot-plant mixing. This test was, therefore, qualified for introduction into The Asphalt Institute Specifications, replacing the old Loss on Heating test.

Low Temperature Consistency, Penetration at 39.2°F. Test; this test was found to have a low degree of reproducibility. It was further found that there was no factual field data showing that a low penetration at 39.2°F. was accompanied by brittleness in the pavement. The test was, therefore, not adopted.

Spot Tests—Oliensis or Xylene Equivalent. No data was available to relate the properties indicated by these tests to pavement performance, particularly at the levels usually specified.

Sliding Plate Micro Viscosity Test. This test has been recognized as a useful research tool and has broadened our knowledge of the viscosity temperature characteristics of asphalt in the medium to low temperature ranges. Project Committee No. 9 has devoted a great deal of time and effort towards co-operating in the development of reproducibility data and refining the test procedure. This work has recently been turned over to the appropriate A.S.T.M. Committee for inclusion among the A.S.T.M. test procedures. Due to the cumbersome nature of the test it may possibly never be included in general control specifications.

Micro Viscometer Ageing Index. This test has also been investigated by Project Committee No. 9 on the same basis as the Micro Viscosity Test. If introduced into a specification it would, of course, replace the Thin Film Oven Test for durability. Due to lack of general availability of equipment and the small amount of field correlation, this test method has been shelved indefinitely by Project Committee No. 9. Reproducibility and repeatability data accumulated during our investigations have also been turned over to the A.S.T.M.

More recently this Committee has been engaged in evaluating test methods for measuring the consistency of asphalts in the temperature range of 32°F. to 275°F. This work is now in its concluding stages and the finding are in the process of being turned over to Project Committee No. 1 to establish test limits for specification purposes.

A third committee related to, but not part of The Asphalt Institute Project Committees, has been established by the Highway Research Board which should appropriately be mentioned at this time.

HIGHWAY RESEARCH BOARD COMMITTEE, AD HOC, FOR RESEARCH PROBLEMS OF MUTUAL INTEREST AND CONCERN TO USERS AND PRODUCERS OF ASPHALTIC MATERIALS

Aside from the length of its title, this Committee is unique in the Asphalt Paving Industry. Its formation represents what is probably the first time that the Users and Producers of asphalt have made a serious effort to resolve, on a national basis, the problems which have been tossed from one to the other for so many years.

The membership of this Committee is made up of six members from the Association of State Highway Officials Materials Committee and six of the technical personnel from the member companies of The Asphalt Institute, plus three ex-officio members and a Chairman and Secretary selected at large.

The Highway Research Board has recently issued a report on the activities of this Committee (H.R.B. Circular 453, October, 1961) an excerpt from which will best outline the first conclusions of the Committee:

"The properties of asphaltic materials which are important in their use in pavements, together with current test procedures which give some information on these properties, are considered by the Committee to be:

Property of Paving Asphalt	**Pertinent Current Test Procedure and/or Specification**
(a) Consistency at use temperatures	Penetration at various temperatures. Furol viscosity at various temperatures. Softening point test. Float test.
(b) Setting rate (time rate of development of consistency)	None
(c) Polar characteristics	None
(d) Chemical reactivity, such as oxygen susceptibility	Penetration retention; 325°F., 5-hr loss on heating test, and/or thin-film oven test.
(e) Colloidal equilibrium	Oliensis test or xylene equivalent.
(f) Volatility	Flash point test and percentage loss on heating; 325°F., 5-hr loss on heating test and/or thin-film oven test.
(g) Rheological characteristics	Penetration ratio, ductility."

"Inasmuch as the test procedures cited have been developed empirically over the years, it cannot be expected that any of them will necessarily evaluate the properties previously cited. The Committee feels that one important research task in asphalt materials today is that of developing procedures to accurately define the fundamental properties of asphaltic materials to be used in pavements and to arrive at common procedures for specifying the necessary grades of asphaltic material."

It is evident that the Highway Research Board Committee has concluded that it is time to wipe the slate clean and start over with new meaningful test procedures to both define the grade of asphalt cements and control their quality.

Action taken by the Committee subsequent to the compilation of the report was to request Project Committee No. 9 to develop a test procedure to determine absolute viscosity of asphalt cements at 140°F. This work has been completed to a point where the test method was turned over to Project Committee No. 1 for refinement and the establishment of tentative limits defininng grade. These viscosity-grade limits are now in the hands of the Highway Research Board Committee to serve as a basis for the construction of specifications for a series of grades of asphalt cements covering the whole usable range of consistency tentatively assumed to extend from 500 to 6000 poises at 140°F.

This short account of one of the accomplishments of a co-operative effort by users and producers of asphalt employing the facilities offered by two of The Asphalt Institute Project Committees and another committee, sponsored by the Highway Research Board, will serve to illustrate the ability of the asphalt industry to co-operate in any serious effort to resolve our problems.

These activities will, of course, ultimately lead to a complete revision of the methods of testing and controlling properties and grades of asphalts. Quite probably none of the current test methods now in common use will be retained.

This will, however, be accomplished only when new specifications and test methods can be based on meaningful and sound engineering practice.