

ASPHALT CONSTRUCTION

Construction of Hot Mix
Asphalt Pavements

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Second Edition

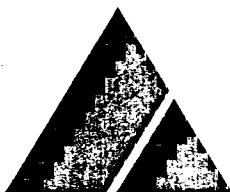


This manual has been prepared to provide the essential information required for the quality control of hot mix asphalt (HMA) pavements. Emphasis has been placed on information which will benefit asphalt construction inspectors, laboratory technicians, plant personnel and paving crews. Since the manual includes technical information on all aspects of HMA pavement construction, it is an excellent reference for anyone involved in asphalt paving operations.

This second edition has been largely rewritten. Chapter 1 has been rewritten as a different, but related, subject from the original version. Chapters 7 and 8 on "Quality Control and Acceptance of Hot Mix Asphalt" and "Segregation," respectively, have been added. The writing and editing of this manual has been a cooperative effort of the Asphalt Institute field engineers, along with the help and cooperation of the headquarters.

The standard practice of the Asphalt Institute is to utilize the International System of Units (SI) (metric), followed by U.S. customary units.

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QUALITY
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Introduction

Each year, billions of dollars are spent on hot mix asphalt (HMA) construction projects in the United States. Achieving good performance of these pavements does not just happen, but is the result of many hours of effort and project management by pavement design and construction professionals. Each phase of a project, from the drawing board to the laboratory to the field, contains important steps and procedures that must be followed to ensure a long lasting, well performing pavement.

Project management has evolved as a tool to plan, coordinate and control the complex and diverse activities of current HMA construction projects. Factors leading to new project management techniques include:

- Economic pressures within the transportation industry.
- Competition between rival contractors.
- A much higher regard for the value and well-being of the workforce and environment.
- Implementation of stringent quality control standards.
- Safety for the construction workforce and public transportation users.

As the title indicates, this manual is devoted to the principles of "Construction of Hot Mix Asphalt Pavements." It is the intent of the manual to provide the technical information necessary to carry out sound construction project management for HMA pavements. The manual has been written for two distinct, yet similar groups of individuals: those employed by the owner or agency of the construction project, and those employed by the construction contractor. Not all personnel from both groups need to know all the information contained in this manual. Obviously, it is necessary to be familiar with the portion directly related to an individual's job. However, an understanding of the entire design and construction process will often provide an appreciation for where a specific task fits into the overall project management process, and thereby ultimately improve in-service pavement performance.

Purpose of Construction Project Management

The primary purpose of HMA construction project management is to foresee and predict as many of the dangers and problems as possible and to plan and control activities so the project may be completed successfully in spite of all the risks. This process starts before any resources are committed, and must continue until all work is finished. The objective is for the final result to satisfy the project owner within the promised time period and without using more dollars and other resources than those originally established by a contract agreement.

Planning and control must be exercised over all the activities and resources involved in the HMA construction project. This can only be accomplished through effective communication. The communication process requires an understanding of the project documents by both the owner representatives and the contractor personnel. It embodies a whole framework of logical and progressive planning and decisions, perceptiveness, a liberal

application of common sense, proper organization, painstaking attention to documentation, and a clear grasp of proven and long-established principles of construction project management.

HMA construction projects have in common the fact that the accomplishment phase must be conducted on a site exposed to the elements and remote from the contractor's facility. These construction projects incur special risks and problems of organization and communication. They often require massive capital investment and deserve (but do not always get) rigorous management of progress, finance and quality.

Construction Project Management is carried out to ensure quality work in compliance with the project requirements. This entails employing active communication in organizing, planning and executing HMA construction projects in accordance with the written instructions detailed in the formal project documents.

First and foremost, both agency and contractor personnel must address the importance of communication concerning the project contract. The *contract* is the agreement between the agency and the contractor. It states the obligations of both parties including criteria for labor, materials, performance and payment. While there are many documents that make up the HMA construction contract, the agency's project manager is concerned primarily with the plans and specifications. Together, the plans and specifications explain requirements that the contractor must fulfill to construct a satisfactory product and be paid in full for the work. Special provisions within the contract normally relate to addenda or supplemental specifications that are project specific.

Plans are the contract documents that show the location, physical aspects and dimensions of the work to be accomplished. They include layouts, profiles, cross-sections and other details.

Specifications are the written technical directions and requirements for the project. *Standard specifications* are included to complement the plans by providing instructions that are not indicated on the drawings. The items normally included in the standard specifications describe the method and manner of executing the work. These specifications normally describe quantities and the quality of materials and labor to be provided under the contract. Material specifications and test procedures from the American Society for Testing and Materials (ASTM) and the American Association of State Highway and Transportation Officials (AASHTO) are listed in the standard specifications and are legally part of the contract documents by reference only. Other documents, such as the Manual on Uniform Traffic Control Devices (MUTCD) and the Occupational Safety and Health Administration (OSHA) regulations are also included in the standard specifications and become a legal part of the contract documents by reference only. Specifications are the means of communication among the contractor and the construction project manager. Specifications are particularly important to the agency and contractor representatives, as they constitute the rules by which the HMA project is managed and accomplished.

Agency/Contractor Relationship

The 21st Century ushers in a new relationship with the agency/contractor in the HMA construction industry. The new relationship is based upon an increasing recognition of the importance of quality during the 1990's. As a result, the Total Quality Management (TQM) concept is being adopted as the key to the HMA industry's ability to compete in today's environment. Partnering, training programs, certification requirements, etc. are integral parts of the overall TQM concept, which involves the following key elements:

- Top management must be committed to the TQM process.
- Quality is derived from the identification, improvement, and control of those processes essential to HMA construction.
- Statistical analysis is necessary to achieve TQM.
- Teamwork and cooperation of all involved is necessary to produce total quality.
- Continual improvement in quality is the focus for TQM.
- Agency/owner satisfaction is the ultimate goal.

In the past, many state and other agencies have performed all of the sampling, testing and approval of materials and processes that were incorporated into the project. In the current environment, many agencies utilize Quality Assurance (QA) type specifications. Under this type of specification, the contractor furnishes the HMA mix designs performed either by its technicians or those of a qualified firm. The contractor is further required to accomplish the quality control (QC) testing on the HMA production and densification. The agency will have a program of acceptance sampling and testing normally performed either by its personnel or a qualified testing firm. In some acceptance programs, the agency will use a combination of contractor test results along with verification tests. The acceptance program confirms the test results of the contractor and gives the agency the documentation necessary for final acceptance and payment for the product. The use of QA/QC specifications has resulted in an improved HMA product. Maintaining and improving the quality of construction will achieve a substantial increase in the pavement life for future HMA construction.

In addition to contractor QC activities, practically all asphalt binder suppliers and many aggregate suppliers conduct extensive testing of their products prior to shipping them to HMA facilities. Virtually all asphalt binders are shipped under certification programs controlled by state agencies. Various programs are employed by aggregate suppliers in cooperation with state agencies to control and verify the quality and gradation of aggregates used in HMA production.

TQM for HMA Construction

The two key TQM processes for HMA construction are hot mix plant production and on-site HMA placement. It is important to the control of a process to establish those characteristics that will lead to a quality product. It would be desirable if a single important characteristic could be chosen for a selected process; however, in the case of HMA construction the processes are too complicated to be properly controlled with just one characteristic. The difficulty of controlling a process drastically increases with the number of measurement characteristics. Therefore, it becomes necessary to minimize the number of chosen characteristics. In addition, there should be precise test methods for each measurement characteristic. The selection of processes, test characteristics and test methods are basic to the quality program, which is only as good as their selection.

In the hot mix plant production process, the aggregate is graded to specific sizes, the mix is heated to a specified temperature, and the aggregate and asphalt binder are mixed to adequately coat each aggregate particle. Past experience has demonstrated that gradation of the aggregate and control of the asphalt binder content are the most important requirements for the control of HMA plants. The ignition test (which is replacing the extraction test) has proven valuable to check the asphalt binder content. Proper calibration either by weight or volume is relatively easy with modern HMA plants to assure the accuracy of both aggregate gradation and asphalt binder content. The accuracy of the measuring devices of a hot mix plant should be checked before the plant is permitted to start producing HMA for a new project. Most modern hot mix plants have computerized controls to permit a running record of the asphalt binder content of the HMA.

The two most important characteristics in the HMA placement process are smoothness and air voids (related to density). Smoothness of the pavement is the most important characteristic for the driving public or agency satisfaction. The driving public is happy as long as the pavement remains smooth and has good traction. Continuous measurement of smoothness is an essential quality requirement.

Proper compaction is paramount to the durability and smoothness of the pavement, and to the achievement of the proper air void content. The volumetric properties of the compacted HMA mixture are the key elements that control the final performance of the HMA pavement. Frequent determinations of the volumetric properties are mandatory to control the placement and compaction process.

Thus far very little has been mentioned about aggregate gradation control. The best way to assure aggregate gradation control is to carefully calibrate the HMA plant. It must be understood that aggregate gradation is closely related to the volumetric properties of the compacted mix. Provided the asphalt content is closely controlled and the HMA is properly compacted, the volumetric properties of the compacted mix provide a measure of gradation variation. In the cases where the contractor's compaction operation is achieving uniform volumetric properties in the pavement, these properties can be used as a measure of aggregate gradation control.

The use of up-to-date techniques enhances the ability to produce quality HMA. Control charts of the asphalt content, aggregate gradation, smoothness, and selected volumetric properties should be maintained and studied to control and improve plant operation. When a control chart indicates problems, immediate attention should be initiated to achieve improved quality. In addition, many of the previously laborious records and reports can be avoided by the routine use of the computer and computerized data recording.

Sampling and Testing

Sampling and testing are methods of evaluating the quality of work. The agency and contractor must agree at the pre-construction conference what sampling is to be performed at the plant and at the roadway, the manner and location in which samples are to be taken, and the number of samples required for a given unit of work. It is the responsibility of both parties to ensure that representative samples are obtained. The samples must be properly identified with the time and date and the location of the source. Both parties must be familiar with quality assurance procedures for sampling and testing. These procedures must be followed to ensure accurate results. If laboratory testing of samples is required, follow-up action should be taken to ensure that tests are performed as scheduled and that the results are properly evaluated.

Safety

Safety is the business of everyone on the project. The project manager must be alert to ensure that safe working conditions and practices are maintained on the project at all times. Safety begins with the project manager, who should set an example in the use of personal safety equipment such as hard hats, gloves, eye protection and protective clothing. In addition, the project manager must see that the safety requirements of the contract are adhered to. This may involve monitoring equipment operation and using such items as barricades, warning lights and reflectors.

Conclusion

Total quality is the key to better performing pavements and satisfying the driving public. With heavier wheel loads and greatly increased average daily traffic expected in the future, TQM is the key to success. Had industry not made the previously mentioned improvements to meet future demands, highway deterioration would be significantly greater than it presently is. History has shown that no matter what level of funding the infrastructure receives, it remains underfunded. Agencies must do more with less for the 21st Century.

In conclusion, this translates into both the agency and the contractor having to work smarter. The material suppliers also play a major role in that they must consistently supply a better product than in the past. The era of Superior Performing Asphalt Pavements (Superpave) is with us. The wheels of progress and technology must continue to turn. The many men and women who perform their duties at the project level will find this manual useful in the discharge of their daily duties.