

technotes

"tech notes" are a product of the State Materials Laboratory to share design and construction technology gained from projects done through WSDOT. This issue is from the Pavements Division discussing HMA View, a database for Hot Mix Asphalt (HMA).

HMA View - Hot Mix Asphalt Database

HMA View is an online database used to monitor hot mix asphalt (HMA) projects throughout their performance life. Monitoring includes browsing, searching and analyzing data ranging from mix design and quality assurance (QA) field data to performance measures such as roughness, cracking, and rutting. A demonstration version (Figure 1), which is populated with Washington State's Superpave projects (1997-2001), is available online at <http://hotmix.ce.washington.edu/hma/> (a new version will be released during the second quarter of 2004).

BACKGROUND

In order to monitor the HMA paving process, a wide variety of QA data must be gathered. The most common fields include aggregate gradation, asphalt content, volumetrics, and in-place density of the HMA. These properties can be used to compare field values with that of a target value or job mix formula (JMF) for determining any potential performance related issues.

A system was required that could link all of the phases of a project together: mix design, construction, rehabilitation, traffic and performance. Using Internet technology, any or all of this information can be presented to users at any location, allowing for remote monitoring of a project.

Users are able to view the data from the paving location, in the construction office, or at the agency/company headquarters. The data is organized by contract and location, with each aspect of the pavement life cycle (project information, mix design, construction, performance and analysis) being a component contributing to an overall view. HMA View supports a wide variety of data types including test results, digital and infrared images, inspection videos, instrument readings, and audio clips.

FEATURES & CAPABILITIES

Data may be entered directly into the database through data entry points via the Internet or through links with HMA Design (the mix design database), QASpec, and Washington State's Pavement Management System (WSPMS). Secure forms have been created to allow users to enter and/or edit the data through any Internet connection. Figure 2 shows the tabular and graphical inputs from the JMF for each aggregate stockpile.

A central storage facility for current and historical data enables users

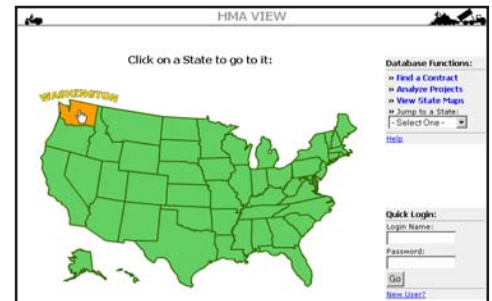


Figure 1. HMA View Homepage.

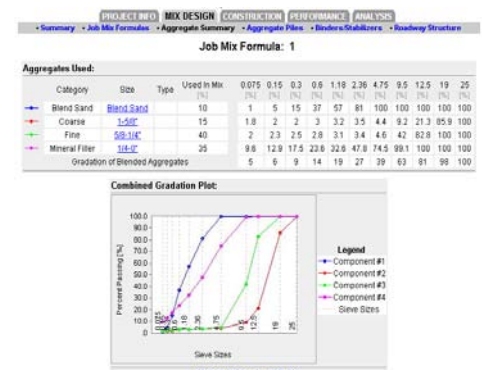


Figure 2. Aggregate stockpile inputs.

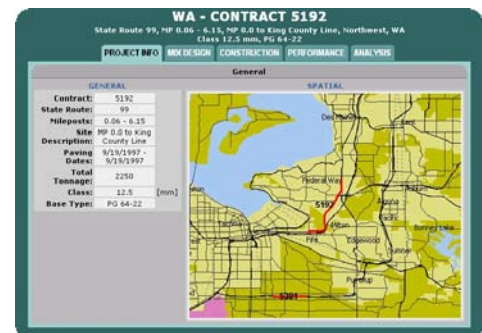


Figure 3. View of tabbed displays.

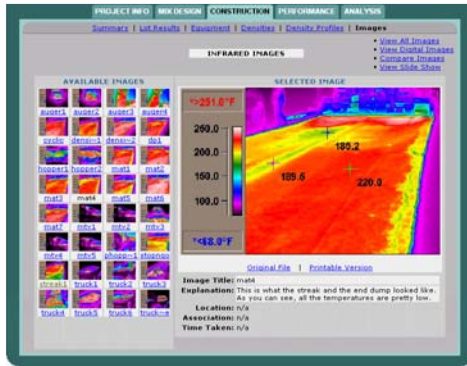


Figure 4. Project infrared images.

to call upon any aspect of a project and helps maintain data integrity. The benefit of a data warehouse is the ability to analyze historical data sets to find trends such as the performance by mix design, type of mix, or location.

BROWSING

Various users may want to review the entire project, others may want to focus on a specific construction aspect of the project, while some may be interested in inter-project comparisons across a geographic region. This can be done using the tabbed displays (Figure 3) within the system.

These create a seamless connection between each of the projects' different components. The tabs are currently organized to display the following:

- Project Info – Provides a quick snapshot of the project, including a spatial view (Figure 3).
- Mix Design – Displays various details regarding the Job Mix Formula(s) used on the project (Figure 2).
- Construction – Includes general site data (equipment used), HMA data (gradation, asphalt content, volumetrics), in-place density data, and media content (photographic or infrared images) (Figures 4 and 6).
- Performance – Displays historical data regarding pavement performance. Traffic statistics are also available (Figure 9). (This data is imported from the WSPMS.)
- Analysis – Allows users to create plots and perform diagnostics on different construction parameters (gradation, asphalt content, volumetric data, and in-place density) (Figures 7 and 8).

The browsing features also support multimedia, allowing users to visually follow the project. For example, the ability to browse through infrared images taken during construction of a project (Figure 4).

QUERIES

HMA View allows users to perform advanced queries on the data within the database. This feature allows users to select a group of projects by any available parameter(s), and perform analysis functions, such as average and standard deviation of air voids (Va), gradation, density, etc.

A parameter-based search will isolate projects based on any data field that is stored in the database. Two search pages are currently available on the site. The first page reveals the most commonly searched fields, including the state and or state route where the project was constructed, the contract number, the paving date, and the class of mix used (Figure 5). The second page allows for more advanced searching capabilities by opening up all searchable fields in the database.

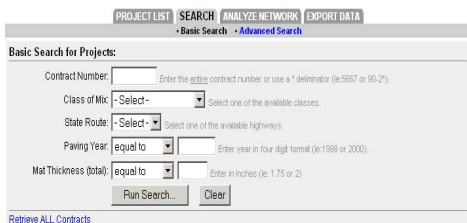


Figure 5. Basic search fields.

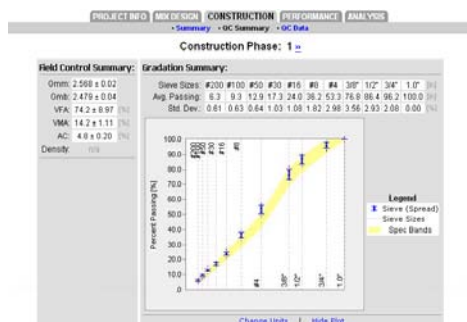


Figure 6. Gradation plot.

ANALYSIS

Users can analyze any aspect of a project by intra and inter-project analysis. Data is available to provide insights to various questions like, 'How well are Superpave projects performing?', 'What factors contributed most to a specific type of pavement failure?', or 'How much of a factor is the mat density on a pavements life?'

HMA View allows users to plot any data fields stored within the database. Custom user-defined charts in nearly any style are possible and can be populated by any of the available data fields in the database. For example, Figure 6 shows a 0.45 power gradation plot with the specification band and the production range of each of the sieves during construction.

Other crucial plots during the construction phase are the field control charts, which provide a look into the trends and current levels of volumetric properties of the hot-mix. Users can add different layers of detail to the plots including: the design line, tolerance limits, specification bands, and the average of the plotted points. The user can then determine whether the data is consistent with the JMF and/or whether the volumetric data is reasonable when compared to the gradation and asphalt content. These types of plots are generated from the data within the database; there is no need to create a graph or calculate an average, it is prepared for the user once they have chosen the features they want to plot (Figure 7).

A set of diagnostic tools has been created to demonstrate the different techniques that can be employed by the various user groups. The diagnostic tools enhance the real-time reporting of the database (custom messages or alerts can be sent when certain conditions are met). A summary of each project can be quickly reviewed and any particular project can be reviewed in more detail, as desired. These summaries show when adjustments in the mix or construction procedures are needed, indicate what adjustments are needed, and provide a record of the effect of any adjustment rate. An example of diagnostic tools can be seen in Figure 8.

A performance summary table based on pavement distress levels can be viewed for each project (Figure 9). This simplified rating system provides a quick reference to pavement performance.

Groups of projects can also be analyzed through the built-in query functions. This feature can be used to compare the performance between projects (i.e. by class of mix, location, PG binder type, etc.). This data, in conjunction with the design and construction data, can provide a complete analysis in terms of performance of a specific project or group of projects. The results can be visually represented on a map for interpretation or a regional analysis.

DATA EXPORT

If additional evaluation of the data is needed, there is the ability to

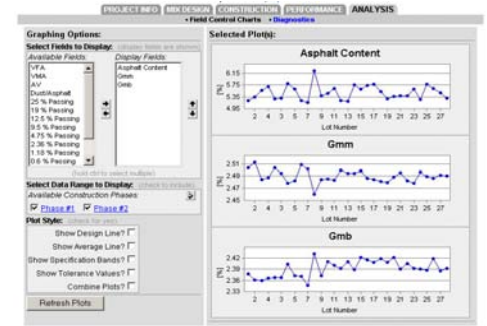


Figure 7. Field control charts.

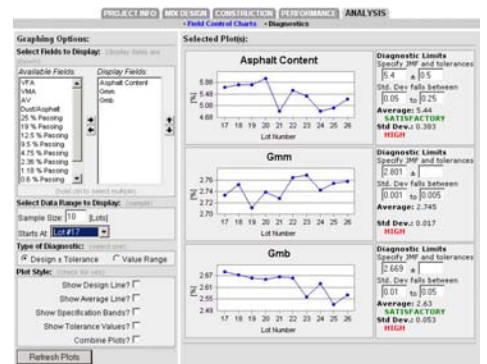


Figure 8. Diagnostic tools.

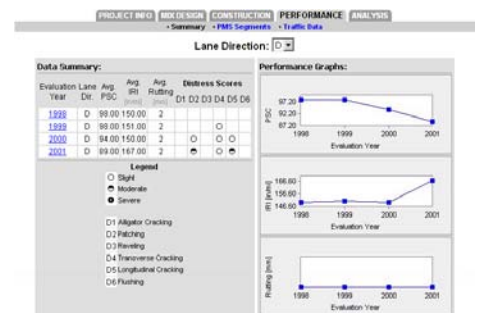


Figure 9. Performance summary table.

export the data into Microsoft Excel®. A user may select any of the data fields in the database for one or more contracts, and have it exported directly to Excel®. As time progresses, other export types may evolve.

SECURITY

HMA View uses a data-warehousing model, which simplifies data backup. In addition to data backup, transaction logs are maintained which keep track of each user's interactions with the database. This will allow for easy rollback in case of errors, as well as user logging to know who is editing the data and when they are doing it.

The online system employs the use of client "portals" to enter and view the data created for individual user groups. In maintaining the database integrity, allowances have been made to draw comparisons and analysis on a larger pool of projects, specifically across different agencies.

By using current technologies, the reliability and performance of the site has been ensured. In the future, HMA View can make use of mirror sites located throughout the country. A mirror site increases availability, and is standard practice in delivering content on the Internet.

In implementing the portals, security is an important consideration. The security is currently implemented by using a login and password scheme. Once logged on to the system, a user is granted privileges to perform certain tasks. User groups may also control what is published into the public domain for viewing.

In delivering content over the Web, software requirements on users are minimized. Only a Web browser and standard plug-ins are required to facilitate the database.

SUMMARY

- HMA View provides users with a tool for storing, retrieving, and analyzing information regarding HMA projects.
- Integrates the design, construction, traffic, and performance data of a project.
- Can provide immediate feedback on contract compliance to the agency and construction personnel, an essential step for improving QA and implementing QC.
- Web-based, which allows users, no matter the location, to view and analyze the same data at the same time.
- The ability to adapt to diverse user requirements.

For more information contact:

Jeff Uhlmeyer
360-709-5485
uhlmej@wsdot.wa.gov



**Washington State
Department of Transportation**