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Standard Guide for Network Level Pavement Management[1]

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1. Scope

1.1 This guide outlines the basic components of a network level pavement management system (PMS).

1.2 This guide is intended for use in the management of traveled pavement surfaces, including roads, airfields and parking lots.

1.3 This guide is not a standard method or practice, that is, it is not intended to provide a comprehensive PMS in a user specific application.

2. Referenced Documents

2.1 *ASTM Standards:*

E 867 Terminology Relating to Traveled Surface Characteristics[2]

3. Terminology

3.1 *Definitions:* All terminology used in this guide conforms to Terminology E 867.

3.1.1 *feature*—(see 3.1.4).

3.1.2 *network level analysis*—evaluation of a network of pavement to enable selection of candidate projects, project scheduling, and budget estimates.

3.1.3 *pavement condition*—a quantitative representation of distress in pavement at a given point in time.

3.1.4 *pavement management section/segment*—a contiguous pavement area considered to have uniform construction, maintenance, usage history, and condition.

3.1.5 *pavement performance*—ability of a pavement to fulfill its purpose over time.

3.1.6 *project level pavement analysis*—evaluation of pavement section to select the type and timing of rehabilitation or maintenance.

4. Significance and Use

4.1 This guide provides network level PMS users with an outline of the basic components of a PMS to ensure the specific system the user selects or develops fulfills the agency needs and requirements.

4.2 This guide may be used by agencies or organizations wishing to develop, evaluate, or refine a network level PMS.

4.3 The basic components of the PMS described in this guide are location reference, information collection, data base management, analysis, implementation, operation and maintenance.

4.4 Within each basic component a list of possible types of data, information, models, etc. are provided for consideration by the user agency. These lists are neither all inclusive nor exclusive. They are intended for guidance only.

5. Basic Components of a PMS

5.1 *Location Reference*—Reference and location for all pavements and information in the system should be identified by a consistent and time stable reference and locations method. Some of the common network referencing methods include: (*a*) link-node, (*b*) branch/facility, (*c*) section/feature, (*d*) milepost, (*e*) log-mile, and (*f*) geo-coordinates.

5.2 *Information Collection*—The fundamental information used in a pavement management system includes: (*a*) pavement inventory, (*b*) pavement condition, (*c*) traffic characteristics, (*d*) environment, and (*e*) cost. This information is used to define uniform sections/features whose locations are identified within the reference method used by the agency. Data collection methods, sampling patterns and frequencies should be chosen that are appropriate to the reliability of information required to meet the needs and objectives of the agency as defined in 3.1.2. Resources should be available to sustain the information collection efforts. Methods should be flexible enough to allow for special conditions. Data may be collected objectively, subjectively, or in combination.

5.2.1 *Pavement Inventory*—The following data may be included: (*a*) length/width/area/geometrics, (*b*) pavement structure, layer types, design strength, and thicknesses, (*c*) construction and rehabilitation history, (*d*) maintenance history, (*e*) drainage, and (*f*) functional classification.

5.2.2 *Pavement Condition*—The following data may be included: (*a*) distress, (*b*) roughness, ride quality, (*c*) skid resistance, texture, (*d*) stiffness, deflection, (*e*) materials and layer properties, and (*f*) drainage.

5.2.3 *Traffic Characteristics*—The following data may be included: (*a*) volume, (*b*) loads, (*c*) vehicle classifications, and (*d*) accidents.

5.2.4 *Environment*— The following data may be included: (*a*) freeze-thaw cycles, (*b*) precipitation, (*c*) solar radiation, and

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[2] *Annual Book of ASTM Standards,* Vol 04.03.

(*d*) pavement temperature variation and range.

5.2.5 *Cost*—The following data may be included: (*a*) construction by pavement type, (*b*) maintenance and rehabilitation by activity, and (*c*) user costs.

5.3 *Database Management*—The use of computers for database management is strongly recommended. All pavement network data should be integrated (see Note 1). Software analysis should transform the data into usable information to assist and or support the decision process. Software and hardware can facilitate the following activities:

5.3.1 Interface the field data collection with a data storage system,

5.3.2 Structure the data base for ready storage, retrieval, maintenance, verification, updating, and integration with other systems,

5.3.3 Interface database with analysis routines, and

5.3.4 Interface with reporting system.

NOTE 1—Users, when planning a system, should be aware of the need to maintain and utilize a historical database in relation to pavement inventory, pavement condition, traffic characteristics, environment and costs.

5.4 *Analysis Component*—The analysis procedures in a pavement management system should be agency specific. Models are commonly incorporated into pavement management systems to accomplish the following objectives: (*a*) performance predictions, (*b*) cost analysis, (*c*) prioritization, (*d*) optimization, and (*e*) consequence analysis.

5.4.1 *Performance Prediction*—Performance curves and models are used for predicting the future condition and serviceability or both, of both existing pavements and rehabilitation or maintenance alternatives.

5.4.2 *Cost Analysis*— Reconstruction, rehabilitation, and maintenance cost data are used to estimate current and future budget needs. Cost data, including user costs, are also used in life cycle cost analysis, cost benefit analysis, prioritization, optimization and consequences analysis.

5.4.3 *Prioritization*— Prioritization models are used to generate lists of candidate projects and scheduling. The present pavement condition, rate of deterioration, traffic, and other agency specific criteria are incorporated into the prioritization equations or algorithms.

5.4.4 *Optimization*— Optimization is the analysis of various maintenance, rehabilitation, and reconstruction strategies at the network level to: (*a*) maximize benefits, or, (*b*) minimize costs, or, (*c*) maximize the extended life of the pavement, or (*d*) maximize cost-effectiveness. Optimization models typically use mathematical techniques such as linear programming, integer programming, or dynamic programming.

5.4.5 *Consequence Analysis*—Consequence analysis provides the agency with the ability to assess the impact of alternative pavement strategies and budget levels on the state of the network.

5.5 *Feedback Component*—In addition to estimating needs, prioritizing candidate projects, and optimizing strategies, the performance and cost data can be used to evaluate maintenance, rehabilitation, and reconstruction designs and techniques. The data can also be used to calibrate design procedures, and other research purposes.

5.6 *Implementation*— Procedures need to be developed for implementation of the PMS within the agency to assure compatibility, usefulness, and acceptability. The plan should define computer hardware and software, equipment, personnel requirements, and organizational structure. The plan may also include a staging process to implement the PMS gradually.

5.6.1 *Operation*—Procedures need to be developed for collection, data entry, quality assurance of data, and ongoing training.

5.6.2 *Maintenance*— Procedures need to be developed for update of data, periodic reporting and other system work, review, evaluation/calibration and improvement of system models.