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LTPP Directive No. GOD-3

Effective Date: December 16, 1996

Distribution: LTPP Staff
LTPP Contractors
LTPP Data Users
Other Interested Parties

Subject: Policy on Incorporating Computed Quantities in the LTPP IMS

Effective immediately, the process and procedures outlined in the attached **Long Term Pavement Performance Program Policy on Incorporating Computed Quantities in the LTPP IMS** shall be followed for all computed quantities proposed for inclusion in the LTPP IMS.

The permanent members of the computed quantities review panel are:

Cheryl Richter, Chairman
Gonzalo Rada
Barbara Ostrom

This policy does not apply to computed quantities already in the IMS UNLESS substantive changes to those quantities, or the tables in which they are stored, are required. In those instances, the quantities in question shall be reviewed according to this policy, as if they were newly proposed computed quantities.

Approved:

LTPP Program Manager

Long Term Pavement Performance Program
Policy on Incorporating Computed Quantities in the LTPP IMS

Introduction

The Long-Term Pavement Performance (LTPP) Information Management System (IMS) was created for storage and dissemination of the pavement performance and related data collected on the LTPP test sections. The IMS was developed to provide research quality data to support a wide range of analyses. In keeping with this, the aim has been to store all data in its most dis-aggregated form. This provides analysts the greatest flexibility in development of new or innovative approaches. The IMS uses a relational data base structure and currently has more than 6,000 distinct data elements stored in more than 400 tables.

Computed quantities refer to some aggregation, calculation, summarization or interpretation of raw data to derive a new data element. Some computed quantities are standard indices with broad acceptance or traditional foundation, such as soil classification. Others are statistical representations of repeat measurements such as the average, mean, standard deviation, etc. of laboratory or other tests. Still others are common indices or measures for which the derivation from raw data is more complex, such as ESALs, rut depth or IRI.

While the aim in LTPP has been to maintain data in its most dis-aggregated form, there have always been **some** computed quantities. In the data base (see Table 1), as well as tremendous interest and pressure to include additional computed quantities. With the ever-increasing use of LTPP data in analyses of pavement performance, both the demand and opportunity for storing additional computed quantities are growing. The framework to manage this demand and opportunity are presented here.

Review Process to Add Computed Quantities to the IMS

A review panel will provide guidance, oversight, review and recommendations on which computed variables should be added to the IMS. The review panel will have three permanent members, and up to seven additional members who participate on a rotating basis to provide the varying expertise required for the wide range of technical issues that will arise. The permanent members will be selected from the FHWA LTPP staff and Technical Support (TSC) or Data Analysis Contractor staff, with an LTPP staff member serving as chairman. For each group of related computed quantities to be considered, rotating members from States, LTPP staff and contractors, industry and academia will be added, as appropriate, based on knowledge and expertise. An important role of the permanent members will be to bring consistency in philosophy, approach and deliverables to the process. Rotating members will primarily contribute technical expertise.

Table 1. Examples of computed quantities currently stored in the LTPP IMS.

Material Properties from Laboratory Testing
Soil class under the Unified and AASHTO systems
Summarized layer structure (analysis section)
Roughness Index from Longitudinal Profile Measurement
International Roughness Index (IRI)
Slope Variance
Climate Data
Number of freeze thaw cycles
Freeze index
Traffic data from monitoring measurements
total annual traffic
annual number of 80 kN equivalent single axle load applications

Review Panel Composition

(1-2) permanent members from FHWA
(0-1) permanent member from TSC
(0-1) permanent member from Data Analysis Contractor
(0-4) rotating participants from states, industry, academia
(0- 3) rotating participants from FHWA staff and LTPP contractors

TOTAL panel membership 3-10

Criteria for Including Computed Quantities

The following criteria will be applied by the review panel in evaluating the acceptability of new computed variables for inclusion in the IMS;

- *Type of variable.* The computed variables should be indices or measures which:
  - can be used to group data into logical analysis groups;
  - represent fundamental material properties;
  - are important factors related to pavement performance and design of new and rehabilitated pavements;
  - have utility in the core analyses to be conducted as part of the LTPP data analysis plan; or

- are otherwise of interest or use to pavement practitioners.

- *Future change potential*. The potential for future change shall be considered. Variables with low to moderate change potential are most suitable for implementation. Quantities requiring subjective interpretation, those for which no recognized standard presently exists, are alternate interpretations of other IMS variables, or are exploratory in nature are not well suited for selection.

- *Computational requirements*. Computed quantities which require data drawn from several different tables, or require significant computational time, should be stored in the IMS, as opposed to being computed "on-the-fly".

- *Documentation* The selected computational approach must be meticulously documented to disclose underlying assumptions, theoretical basis, and computational procedures. Algorithms developed as part of the procedure must be placed in the public domain.

- *Use of non-LTPP data elements*. The degree to which a computed quantity is based upon data elements not included in the LTPP-IMS shall be assessed relative to independent confirmation of the computation. Quantities that are heavily dependent upon external data are not appropriate for inclusion, unless the missing data elements are well documented or included as an entry in the table containing the computed value. As an example, weather statistics derived from National Climatic Data Center weather data are non-LTPP data elements already included in the LTPP-IMS. The supporting data for these statistics are readily available, and the process for incorporating them into the IMS has been well documented. A similar standard shall be met for other computed quantities requiring non-LTPP data elements.

- *Free Access*. After entry into the IMS, data users must be free to use these computed quantities or to develop new values for their specific investigation based on their independent interpretation of the raw data elements.

- *Availability of Resources* There are many technical and administrative activities associated with each new computed quantity (see *Operational Requirement*.). The effort to develop new variables must be weighed against the anticipated frequency of use of those values in product development.

Operational Requirements

The largest impact on the LTPP program from computed quantities will be the resources required for defining, creating and analyzing the specified quantities. These types of new computational variables are not expected to have a significant impact on the coding, storage, and dissemination aspects of the data base. Because the data base is optimized for storage and not for internal manipulation of data, computations will generally be conducted outside of the IMS. The raw data will be extracted from the IMS, the new quantities will be calculated and the resultant

new data then filtered back into new tables of the IMS.

For computed quantities recommended by the review panel for inclusion in the IMS, responsibility will be assigned for each of the necessary operational steps;

- establish variable and IMS table(s) definitions for storage of the computed quantities,
- define the computational algorithms to create the new variables,
- technical review of the computational methodology,
- create the computational computer code and specify the output format,
- code the IMS software for filtering and storing of the computed quantities,
- create quality control definitions and check software,
- process the data to create, store and check the new computed quantities.

Decisions and Assignments

The LTPP staff will make final decisions as to the addition of any computed quantity to the IMS, and related work assignments. Factors considered in these decisions will include contractual limitations, budgets, and program priorities, as well as the technical considerations identified by the review panel.

Initiation of the Process

The process for adding a new computed quantity to the IMS may be initiated by anyone involved in collection, processing, use, or analysis of LTPP data, at any time. The process is initiated by submitting the Recommendation Form (Attachment 1) to the Chairman of the evaluation panel. Although it is desirable to have computed quantities which originate in LTPP-sponsored analysis formally considered at the outset, time constraints in the analysis activity may require adding computed quantities to the IMS after the fact. There will be instances in which computed quantities used in a particular analysis activity will fail to meet the criteria for inclusion in the IMS.

Recommendation of
Computed Quantity for Inclusion in the LTPP IMS

Please provide the information requested below to the extent feasible.

Identification/description of proposed variable:	
Engineering significance of proposed variable:	
References and applicable documentation:	
Data required for computation:	
Method of computation (spreadsheet, standalone software, subjective interpretation, etc., with details as appropriate/feasible):	
Potential/probable applications of proposed variable:	
Submitted by:	**Date:**

EXAMPLE

Recommendation of
Computed Quantity for Inclusion in the LTPP IMS

Please provide the information requested below to the extent feasible.

Identification/description of proposed variable: In situ moisture content derived from TDR probes for seasonal monitoring sites.
Engineering significance of proposed variable: Causal/explanatory variable for seasonal variations in pavement structural characteristics (stiffness and strength).
References and applicable documentation: LTPP Seasonal Monitoring Program Instrumentation Installation and Data Collection Guidelines, FHWA-RD-94-110, April 1994 Determining Soil Volumetric Moisture Content Using Time Domain Reflectometry, John Andrew Klemunes Jr., Masters Thesis, University of Maryland, 1995. Additional documentation to be developed.
Data required for computation: TDR data, soil classification
Method of computation (spreadsheet, standalone software, subjective interpretation, etc., with details as appropriate/feasible): TBD (spreadsheet probable)
Potential/probable applications of proposed variable: Analyses addressing seasonal variations in pavement structural characteristics; the development of predictive relationships for pavement layer moduli

Submitted by: Cheryl Richter	**Date:** 11-14-96