Lecture #8 & #9:

◎ Data Requirements
(Haas, Chapter 6-14)
Inventory of Pavement Management Data Needs, Pavement Performance, Pavement Evaluation (Structural Capacity, Condition Surveys, Safety), Feedback Database Management

◎ Pavement Management Data Needs

1. Classes of Data Needed & Uses

※ Section Description, Performance, Historic, Policy, Geometry, Environment, and Cost Related Data (Fig. 6.1, 6.2)

※ Typical Uses: Network & Project Levels (Table 6.1)

2. Importance of Construction & Maintenance History Data
3. Importance of Performance Related Pavement Evaluation

(a) Roughness: Serviceability & Riding Comfort;
(b) Surface Distress;
(c) Deflection: for Structural Adequacy;
(d) Surface Friction: for Safety

Section Description	R + M	Geometry Related Data	
		• Section dimensions	R
Performance Related Data		• Curvature	R
• Roughness	R	• Cross slope	R
• Surface distress	R + M	• Grade	R
• Deflection	R	• Shoulder / curb	R + M
• Friction	R + M		
• Layer material properties	R		
		Environment Related Data	
Historic Related Data		• Drainage	R + M
• Maintenance history	R + M	• Climate (temperature, rainfall, freezing)	R
• Construction history	R + M		
• Traffic	R + M		
• Accidents	R + M	Cost Related Data	
Policy Related Data		• Construction costs	R
• Budget	R + M	• Maintenance costs	R + M
• Available alternatives (maintenance & rehabilitation)	R + M	• Rehabilitation costs	R
		• User costs	R

R: data used primarily for rehabilitation   R + M: data for both uses

M: data used primarily for maintenance

Figure 6.1 Major classes and component types of pavement data [Haas 91].

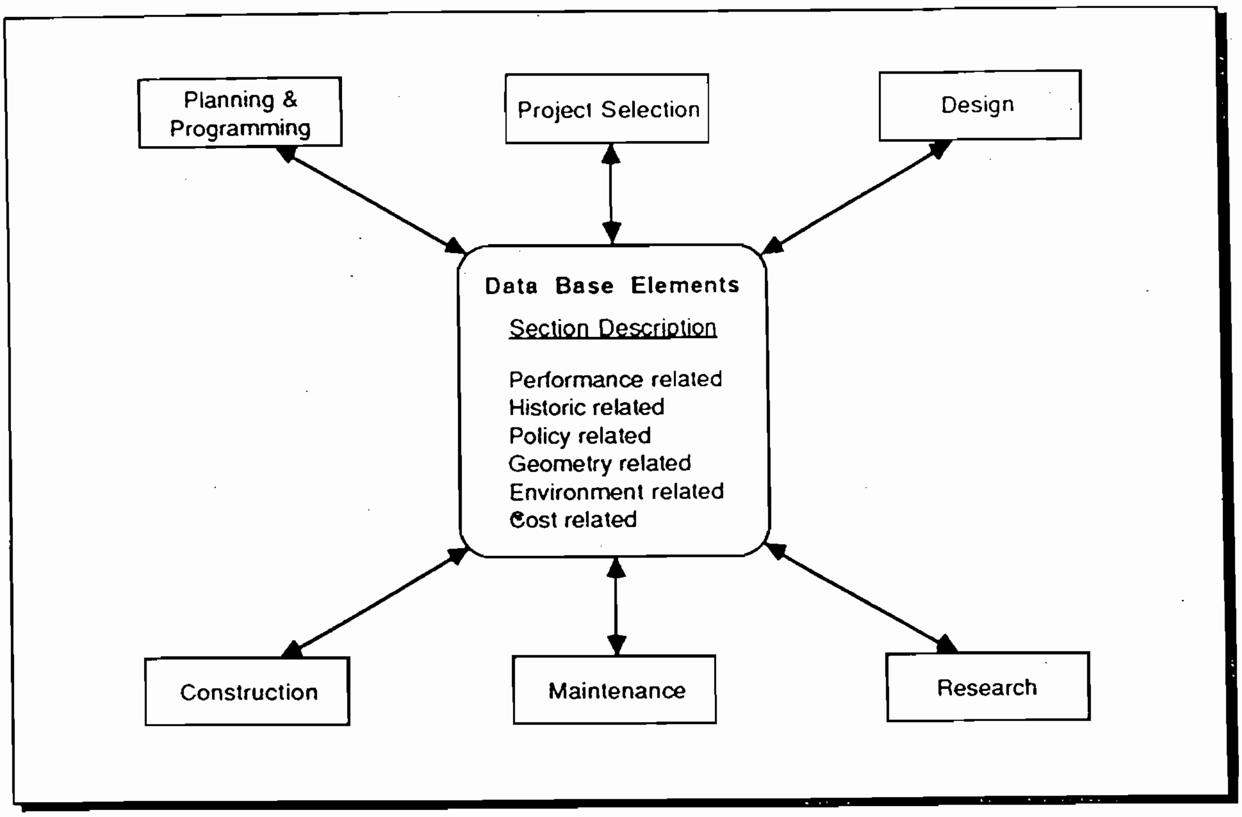


Figure 6.2 Data base as a central feature of the PMS

Table 6.1 Typical Uses of Pavement Management Data [Haas 91]

Data Item	Network Level	Project Level
1. PERFORMANCE RELATED		
Roughness	a) Describe present status b) Predict future status (deterioration curves of roughness vs. time or loads) c) Basis for priority analysis and programming	a) Quality assurance (as-built quality of new surface) b) Create deterioration curves c) Estimate overlay quantities
Surface distress	a) Describe present status b) Predict future status (deterioration curves) c) Identify current and future needs d) Maintenance priority programming e) Determine effectiveness of alternative treatments	a) Selection of maintenance treatment b) Identify needed spot improvements c) Develop maintenance quantity estimates d) Determine effectiveness of alternative treatments
Surface Friction	a) Describe present status b) Predict future status c) Priority programming d) Determine effectiveness of alternative treatments	a) Identify spot or section rehabilitation requirements b) Determine effectiveness of alternative treatments
Deflection	a) Describe present status b) Predict future status (deterioration curves) c) Identify structural inadequacies d) Priority programming of rehabilitation e) Determine seasonal load restrictions	a) Input to overlay design b) Determine as-built structural adequacy c) Estimate remaining service life d) Estimate remaining load restrictions
Layer Material Properties	a) Estimate section-to-section variability b) Develop basis for improved design standards	a) Input to overlay design b) Provide as-built records
2. HISTORIC RELATED		
Maintenance History	a) Maintenance programming b) Evaluate maintenance effectiveness c) Determine cost-effectiveness of alternative designs and treatments	a) Identify problem sections

4. Objectivity & Consistency in Pavement Evaluation
   "Repeatable"
   "Consistent" across Time & Space
   Well-documented Set of Practices & Procedures + Good Training
5. Combining Pavement Evaluation Measures
   Overall Pavement Quality Index
   "Detailed Pavement Condition Information is NOT Necessary at All Levels of Pavement Management."
   e.g., Senior Administrators may Only be Interested in Summary Descriptions of ...

◎ Inventory Data Needs

1. Types of Inventory Data
   Section Reference & Description, Geometry, Pavement Structure, Costs, Environment (Weather) & Drainage, Traffic
   ※Referencing Method (Hass, page 71)
   Route-Milepost / Node-Link / Branch-Section / GIS (==> Effective Database)
   ※Branch-Section Method used in PAVER
   Uniform Section: Homogeneous Characteristics
   Workable, Consistent, & Amendable to Updating
2. Collecting & Processing Inventory Data

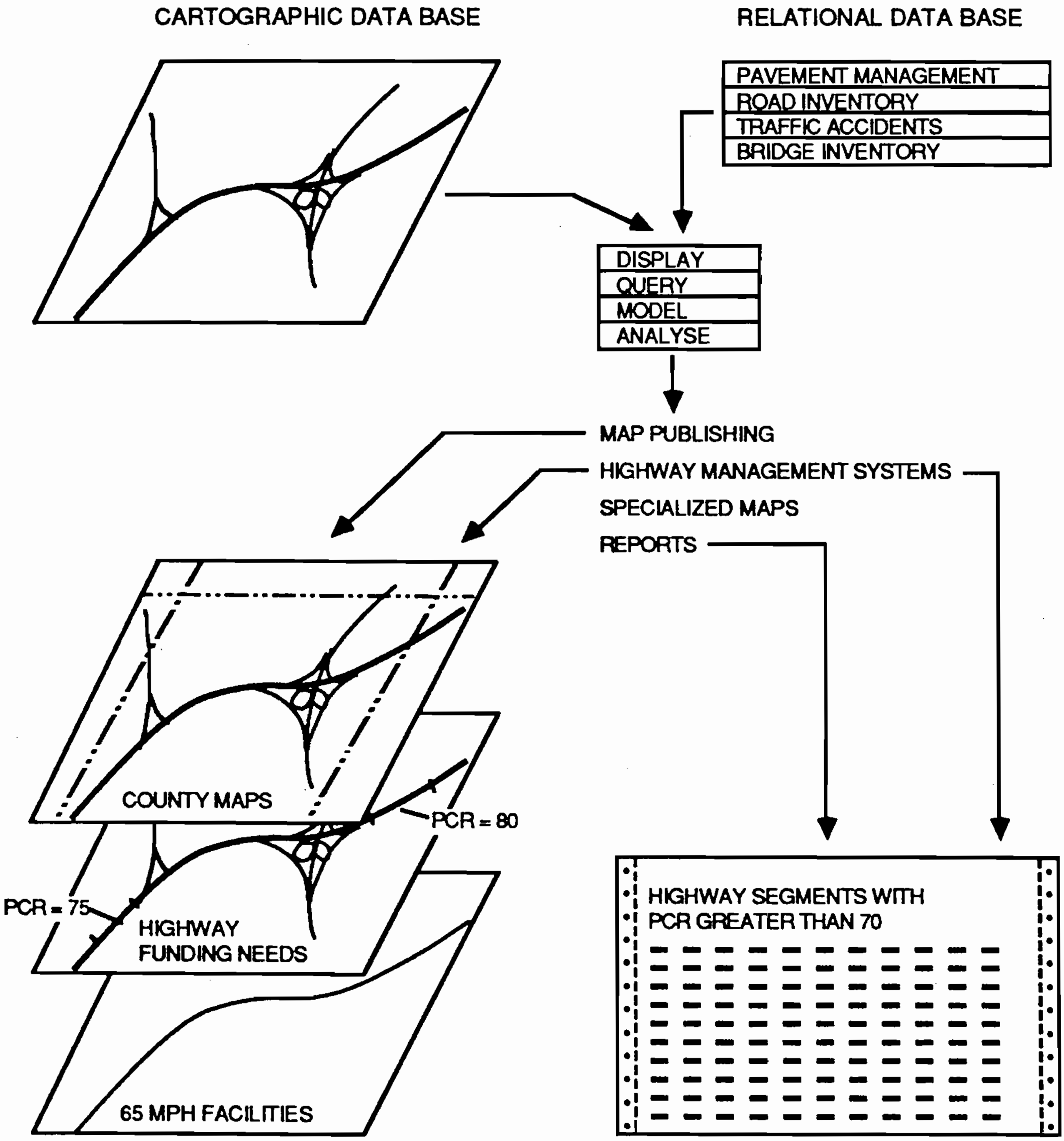


Figure 7.1 Interaction of geographic information system and pavement management, based on a North Carolina DOT feasibility report [NC DOT 88].

milepost system for referencing sections. Data is collected at each milepost in the system. Management decisions are based on construction projects, yet these projects rarely begin or end at an exact milepost. Thus, the location of changes in the pavement structure, which can affect performance, are not identified in the data base.

The advantage of selecting pavement sections with homogeneous characteristics is ease of analysis of the data. The condition of each pavement section can be evaluated and maintenance or rehabilitation plans can be formulated. Section boundaries are usually defined based on selected control parameters, such as construction contract beginning or end, traffic levels, maintenance districts, intersection with another major

◎ Pavement Performance

1. Serviceability-Performance Concept
   AASHO Road Test

※ Functional Pavement Rating: User's Perception, Vertical Acceleration, Experienced Driving ==> Roughness Characteristics, Vehical Mass, Suspension Parameters, Travel Speed

※ Pavement Serviceability Index (PSI)
   "Subjective" PSR => Measured Objectively

2. Characteristics of Pavement Roughness

※ AASHO Road Test: About 95% of Pavement Serviceability Information is Constributed by <u>"Roughness of Surface Profile"</u>

※ Roughness=Distortion of Pavement Surface
   ==> Undesirable or Uncomfortable Ride

※ Three Profile Components: Longitudinal, Transverse, & Horizontal Distortions
   (Longitudinal => Vertical Acceleration)
   (Vehicle Roll & Yaw =>Lateral Acceleration)

3. Equipment for Evaluating Roughness
   1920's Recognized the Need
   Late 1950's AASHO Slope Profilometer

CHOLE Profilometer (剖面儀): record angle of 1 foot intervals, 5 mph (slow speed)

(1) Profile measurement devices:
 (a) Face dipstick
 (b) TRRL profilometer (high-sped road monitor)
 (c) Inertial profilometers: General Motors Research (GMR) or Surface Dynamics Profilometer (SDP), FHWA profilometer, APL profilometer, Low cost profile based devices (Law Model 8300 Roughness Surveyor, South Dakota Profiler)

(2) Profilographs:
 Rolling straight edge devices or profilographs

(3) Response type measurements:
 Response type road roughness measuring systems (RTRRMS) or devices
 (a) Mechanical RTRRMS: Bureau of Public Roads (BPR) roughometer, Mays Ride Meter (MRM) or Maysmeter
 (b) Accelerometer-Based RTRRMS: Automatic Road Analyzer (ARAN), etc.

4. 高公局之糙度量測儀器

K. J. Law SDP M8300 表面動力剖面儀
(Surface Dynamics Profilometer)

林嘉永（一.二 [illegible]）

=> SDP可計算均方加速指標(Root-Mean Square Acceleration Index, RMSA)與梅斯指標(MaysMeter Index)

=>梅氏儀糙度值(MaysMeter Roughness, cm/km)，超過某平坦度以上高低值之總和

台灣區高速公路路面養護管理系統建議：

路面類型	新路面驗收值	養護臨界值
剛性	86-103 (96)	134-150 (142)
柔性	32-55 (47)	86-103 (94)

(期終報告：pp. 139-140)

5. A Universal Roughness Standard

(a) Quarter-Car Simulation ==> Quarter-Car Statistics (QCS) ==> International Roughness Index (IRI)
Highway Safety Research Institute (HSRI)
Recommended by the World Bank

(b) Root Mean Square Vertical Acceleration (RMSVA)
MO = -20 + 23 * RMSVA4 + 58 RMSVA16
PSI = 5 * e^(- 9.387 * ln (32 * MO) / 8.493)
MO=Maysmeter Output (MO, in/mile)
RMSVA=RMSVA (ft/sec^2)

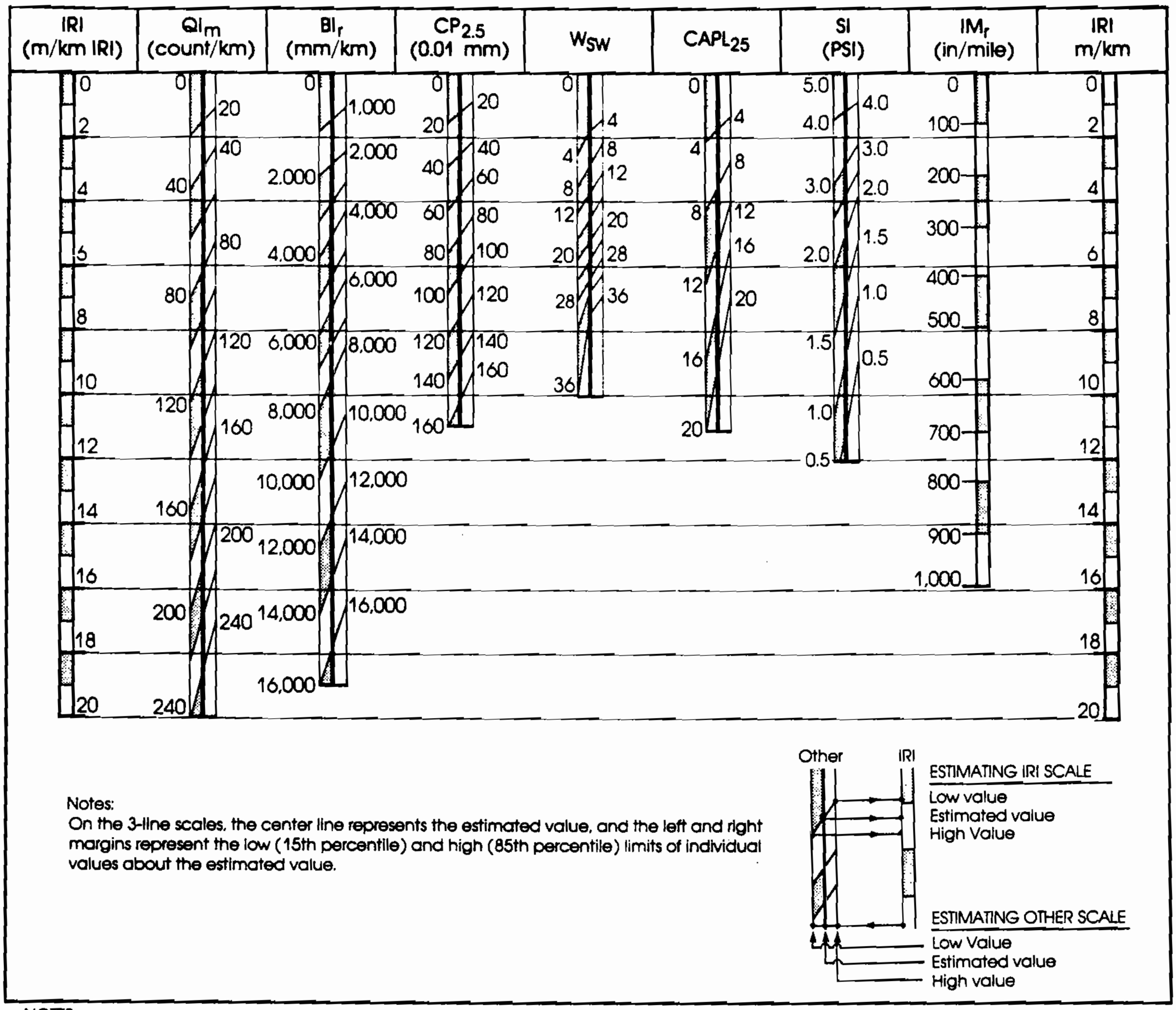
Table 2.5: Relationships and statistics for conversions between roughness scales

Conversion relationship		Standard error	C. V.%	Bias slope	Units
IRI	$= QI_m/13$	0.919	15.4	0.989	m/km
	$= (QI_r + 10)/14$	0.442	7.3	0.975	"
	$= 0.0032\ BI^{0.89}$	0.764	12.7	1.008	"
	$= CP_{2.5}/16$	0.654	12.4	0.993	"
	$\simeq 5.5 \log_e (5.0/PSI)$	-	-	-	"
	$= 0.80\ RARS_{50}$	0.478	7.9	1.002	"
	$= 0.78\ W_{sw}^{0.63}$	0.693	11.5	0.994	"
	$= CAPL_{25}/(2.2 + 0.8A)$	1.050	17.4	1.030	"
QI_m	$= 13\ IRI$	12.0	15.3	0.993	counts/km
	$= 9.5 + 0.90\ QI_r$	14.5	18.7	0.985	"
	$= BI/(55 + 18\ E)$	11.7	15.0	1.002	"
	$= 0.81\ CP_{2.5}$	11.7	17.2	0.986	"
	$\simeq 72 \log_e (5.0/PSI)$	-	-	-	"
	$= 7.9\ W_{sw}^{0.70}$	8.78	11.2	0.996	"
	$= 6.2\ CAPL_{25}$	18.29	23.3	1.13	"
QI_r	$= -10 + 14\ IRI$	6.32	8.3	1.024	"
BI	$= 630\ IRI^{1.12}$	694	14.7	0.998	mm/km
	$= 36\ QI_m^{1.12}$	1100	22.8	0.985	"
	$= (55 + 18\ E)\ QI_m$	673	14.2	0.976	"
	$= 62\ QI_r$	850	18.1	0.971	"
$CP_{2.5}$	$= 16\ IRI$	10.5	12.4	0.994	0.01 mm
	$= 11 + 1.12\ QI_r$	14.8	17.6	0.995	"
	$= 1.23\ QI_m$	14.4	17.2	0.986	"
	$= 11.7\ W_{sw}^{0.66}$	8.87	10.5	1.018	"
MO_m	$= IRI/1.5$	0.25	0.9	1.04	m/km
MO_i	$= 42\ IRI$	16.0	0.9	1.04	in/mile

Note:
- E = 1 if earth surface, = 0 otherwise.
- A = 1 if asphalt surface, = 0 otherwise.
- BI = TRRL Bump Integrator trailer at 32 km/h (mm/km).
- $CP_{2.5}$ = APL Profilometer coefficient of evenness (.01 mm)
- IRI = International Roughness Index (m/km).
- QI_m = Roadmeter-estimate of QI roughness (counts/km).
- QI_r = Profile RMSVA-function of QI roughness (counts/km).
- $RARS_{50}$ = ARS response of reference roughness simulation at 50 km/h (Sayers, Gillespie and Queiroz, 1986).
- W_{sw} = Short wavelength (1-3.3 m) energy index of APL72
- $MO_{m,i}$ = Maysmeter Output function of PMSVA (Table 2.4) (m/km; inch/mile)

Source: Computer analysis of data from Sayers, Gillespie and Queiroz (1986) and Sayers and Gillespie (1986).

Figure 1.4: Chart for Approximate Conversions between the International Roughness Index (IRI) and Major Roughness Scales



NOTES:
Conversions estimated on data from the International Road Roughness Experiment, (Sayers, Gillespie and Queiroz, 1986) as follows:

1. IRI — International Roughness Index (Sayers, Gillespie and Paterson, World Bank Technical Paper 46, 1986)
2. QI_m — Quarter-car Index of calibrated Maysmeter, Brazil-UNDP Road Costs Study
   $\hat{IRI} = QI_m/13 \pm 0.37\sqrt{IRI}$ $IRI < 17$
3. BI_r — Bump Integrator trailer at 32 km/h, Transport and Road Research Laboratory, UK:
   $\hat{IRI} = 0.0032\ BI_r^{0.89} \pm 0.31\sqrt{IRI}$; $IRI < 17$
4. $CP_{2.5}$ — Coefficient of planarity over 2.5m baselength for APL72 Profilometer, Centre de Recherches Routiers, Belgium:
   $\hat{IRI} = CP_{2.5}/16 \pm 0.27\sqrt{IRI}$; $IRI < 11$
5. W_{sw} — Short Wavelength Energy for APL72 Profilometer, Laboratoire Central des Ponts et Chaussées, France
   $\hat{IRI} = 0.78\ W_{sw}^{0.63} \pm 0.69\ IRI$; $IRI < 9$
6. $CAPL_{25}$ — Coefficient of APL25 Profilometer, Laboratoire Central des Ponts et Chaussées, France:
   $\hat{IRI} = 0.45\ k\ CAPL_{25} \pm 16\%$; $IRI < 11$
   where k = 1 for general use, k = 0.74 for asphalt concrete surfaces, k = 1.11 for surface treatment, earth or gravel
7. SI — Serviceability Index, American Association of State Highway and Transportation Officials:
   $\hat{IRI} = 5.5 \ln(5.0/SI) \pm 25\%$; $IRI < 12$
8. IM_r — Inches/mile equivalent of IRI from Reference Quarter-Car Simulation at 50 mile/hr (see 'HSRI-reference' in Gillespie, Sayers and Segel NCHRP report 228, 1980; and '$RARS_{80}$' in Sayers, Gillespie and Queiroz, World Bank Technical Paper 45, 1986):
   $IRI = IM_r/63.36$

Source: Paterson (1987).

determined, then subjective criteria can be established to determine the roughness levels that correspond to various levels of riding quality or comfort.

8.4.1 Roughness Summary Statistics

Pavement profile data is elevations at discrete intervals along a pavement surface. Raw profile data cannot be readily used by the pavement engineer. It must be processed or filtered in some manner to produce a meaningful representation of the pavement roughness. Originally, digital filtering techniques were used in an attempt to extract wavelength and amplitude information from the profile data using power spectral density analysis techniques [Hutchinson 65]. While this approach provides useful information on the specific components of pavement roughness in the profile data, the technique has not been widely applied. A 1984 review of the techniques for computing a roughness summary statistic found three types in common use [Hudson 84]:

1. Quarter-car simulation
2. Root-mean-square vertical acceleration (RMSVA)
3. Slope-variance (SV)

Additional summary statistics that have found some degree of use include mean absolute vertical acceleration (MAVA) and Straight Edge Index (SEI), as pointed out in a 1983 study [Joseph 83]. As well a "profile index" was introduced in 1985 as the result of research performed for the National Cooperative Highway Research Program [Janoff 85].

8.4.1.1 Quarter-car Simulation

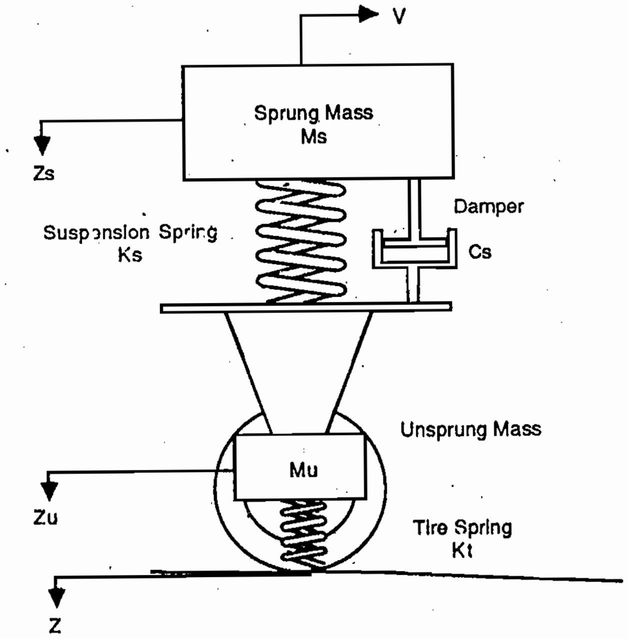
The concept of quarter-car simulation as a method for analyzing pavement profile data was originally an attempt to simulate the output of the BPR roughometer. Subsequently, vehicle simulation studies at the University of Michigan demonstrated that full-car and half-car simulation models do not provide an advantage over the quarter-car simulation with respect to the calibration of RTRRMS devices and are computationally much more complicated [Gillespie 80].

The parameters of the quarter-car are shown in Figure 8.12. They include the sprung mass of the vehicle body; the suspension spring and damper (shock absorber) constants; the unsprung mass of the suspension, tire, and wheel; and the spring constant of the tire. Theoretical correctness would require a damper constant for the tire; however, practical application generally ignores this term. Mathematically the behavior of a quarter-car can be described with two second order equations:

$$M_s\ddot{Z}_s + C_s(\dot{Z}_s - \dot{Z}_u) + K_s(Z_s - Z_u) = 0 \qquad (8.1)$$

and

$$M_s\ddot{Z}_s + M_u\ddot{Z}_u + K_t(Z_u - Z) = 0 \qquad (8.2)$$



Quarter-Car Model

Figure 8.12 Quarter-car model [Gillespie 80].

where

Z = road profile elevation points
Z_u = elevation of unsprung mass (axle)
Z_s = elevation of sprung mass (body)
K_t = tire spring constant
K_s = suspension spring constant
C_s = shock absorber constant
M_u = unsprung mass (axle)
M_s = sprung mass

The double dot notation above the elevation terms represents acceleration while the single dot represents velocity.

Since RTRRMS devices generally measure the movement between the vehicle axle and body, simulation requires calculation of the difference in elevation between the body and axle in response to the road profile and forward motion of the vehicle. This is accomplished by integrating the difference in the velocities between the sprung and unsprung mass; producing the quarter-car statistic, QCS:

$$\text{QCS} = \frac{1}{C}\int_0^T |\dot{Z}_s - \dot{Z}_u|\, dt \qquad (8.3)$$

(c) Slope variance

$$SV = \frac{\sum X^2 - \frac{1}{n}\left(\sum X\right)^2}{n-1}$$

(d) Profile index

6. Relating Roughness to Serviceability

PSI = 5.41- 1.80 log(0.40R-30) - 0.09 (C+P)^0.5

※ Recommendations:

"Distress Terms should be Excluded from the Serviceability Equations"

(Hass's Textbook P.103)

※ Development of Serviceability-Roughness Relationships

PSR=5*e^(α*IRI)

α=−0.0041 for IRI in (in/mile)

α=−0.26 for IRI in (mm/m)

α=−0.0026 for IRI in (cm/km)

(Note: 1 in/mile = 1.578 cm/km,

1 in/mile = 0.01578 mm/m)

7. Application of Roughness Data

Network Level & Project Level

TECHNICAL REPORT STANDARD TITLE PAGE

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16. Abstract

This report documents the work accomplished on a study to develop relationships between the International Roughness Index (IRI) and the Present Serviceability Rating (PSR) for pavement types included in the HPMS database (flexible, rigid and composite pavement types). PSR is defined as the mean user panel rating for rideability.

Relationships between IRI and PSR were analyzed for the states of Louisiana, Michigan, New Jersey, New Mexico, and Ohio which were found in the NCHRP Project 1-23 database, plus some additional data obtained from Indiana. Data for all six States were entered into a SAS data set and the following nonlinear model was found to best fit the boundary conditions and the actual data:

$$PSR = 5 * e^{(\alpha * IRI)}$$

Regression analysis was conducted for all possible sets of data considering different States and pavement types. It was determined that there was no significant difference between the models for different States, and pavement types, thus the following model is recommended:

$$PSR = 5 * e^{(-0.0041 * IRI)}$$

where IRI is in units of in/mile, or:

$$PSR = 5 * e^{(-0.26 * IRI)}$$

where IRI is in units of mm/m.

17. Key Words	18. Distribution Statement		
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Form DOT F 1700.7 (8-69)

DATA ELEMENT CATEGORIES

I. Pavement Management Section Identification & Location

II. Construction/Rehabilitation

III. Project Design

IV. Structural Design

V. Materials & Soils Properties

VI. Construction History

VII. Joint Design

VIII. Subdrainage

IX. Reinforcing Steel

X. Detailed Condition Survey

XI. Friction Characteristics

XII. Deflection Data

XIII. Roughness Information

XIV. Maintenance

XV. Traffic Loading

XVI. Climatic History

XVII. Condition Rating Survey (CRS)

DATA ELEMENT LEVELS

Many different data elements have been identified as being requied for the IPES data base. However, all identified data elements need not be included for every pavement management section due to the different uses of the various data elements. Three general levles showing this general "need" are identified as follows:

LEVEL 1 - PROGRAMMING NEEDS

Data required for Districts and the Office of Planning and Programming to identify projects for prioritization in the multi-year programming process. Also, data required for identification and lcoation of key design features and traffic conditions.

Data elements at this level are required for all Pavement Management Sections within the identified highway network.

LEVEL 2 - POLICY AND DESIGN EVALUATION NEEDS

Data required for evaluation and development of IDOT pavement policies, standards, and design procedures. Data would also be used in establishing rehabilitation decision making criteria.

A representative sample of Pavement Management Sections would be included to gather this level of data.

LEVEL 3 - RESEARCH AND SPECIAL STUDIES NEEDS

Very detailed data required for special/unusual pavement research needs and special studies. Experimental projects would be included in this level.

A small sample of Pavement Management Sections would be included dependent upon the scope of the study.

NOTES ON LEVELS

All data in Level 1 would be required for Level 2 sections, and all data in Levels 1 and 2 would be required for Level 3 sections.

DATA SOURCE TABLE

Data Source	Description	Primary Responsible Agency
BCA	Contractors Information System	Construction
Const.	Construction Job Records and Documentation	Districts
DPI	Roadway Inventory	Urban Program Planning
GAI	Accident Information System	Traffic Safety
MISTIC	Materials Test Records After 1/1/77 - Computerized Pre-1977 ----- Archives	Materials & Physical Researc
MMI	Maintenance Management Information System	Maintenance
Plans	As-built Plans	Districts
PMF	Interstate Pavement Management File	Design
PR	Physical Research Test Data	Materials & Physical Researc
U of I	Climatic Information	University of Illinois

I. PAVEMENT MANAGEMENT SECTION LOCATION AND IDENTIFICATION

Data Element	Level	Example	Units	Data Source
Marked Route	1	I-72		PMF
Management Section Begin MP	1	67.70		PMF
Management Section End MP	1	72.88		PMF
Direction	1	S		PMF
District	1	5		PMF
County	1	Piatt		PMF
Multi-Year Program Status	1			
Remarks	1			
High Accident Location	1	Yes		GAI
Annual Accident Rate/ Statewide Rate	1	1.1		GAI
Pavement Priority	1	3-5	Years	PMF

II. CONSTRUCTION/REHABILITATION

Data Element	Level	Example	Units	Data Source
Year of Improvement	1	1983		PMF
Improvement Cost	1	5,000	$000/Mile	BCA
Improvement Type	1	4.0" Class I		PMF
Improvement Contract No.	1	36923		
Improvement Section No.	1	53-4(1)		PMF
Beginning Milepost	1	67.70		PMF
Ending Milepost	1	74.35		PMF

III. PROJECT DESIGN

Data Element	Level	Example	Units	Data Source
Contract Number	1	32134		Plans
Letting Date	1	4/69		Plans
A) Original Design				
Number of Lanes	1	4		PMF
Lane Width	1	12	Ft.	Plans
Pavement Type	1	10" CRCP		PMF
'eft Shoulder Surface Type	1	6" BAM		Plans
Left Shoulder Base Type	1			Plans
Left Shoulder Stabilized Width	1	6.0	Ft.	Plans
Left Shoulder Aggregate Width	1	2.0	Ft.	Plans
Left Shoulder Total Width	1	8.0		Plans

III. PROJECT DESIGN (Continued)

A) Original Design (Continued)

Data Element	Level	Example	Units	Data Source
Right Shoulder Surface Type	1	6" BAM		Plans
Right Shoulder Base Type	1			Plans
Right Shoulder Stabilized Width	1	10.0	Ft.	Plans
Right Shoulder Aggregate Width	1	0.0	Ft.	Plans
Right Shoulder Total Width	1	10.0	Ft.	Plans
Special Experimental Feature Flag	1			PR
Remarks	2			
1, Pavement Type Concrete				
Concrete Subbase Type	1	4" BAM		Plans
2) Pavement Type Asphalt				
Base Course Type	1	11" BAM		Plans
Asphalt Subbase Type	1	6" Gran		Plans
B) Rehabilitation Design				
Rehabilitation Type	1	3" Class I Mix D	AC Overlay	PMF
Shoulder Rehabilitation Type	1	Resurface 3"		PMF
Restored Shoulder Stabilized Width	1	10.0	Ft.	Plans
Underdrain Flag	1	Yes		PMF
'd Lanes	1	No		Plans
Widening	1	No		Plans
1) AC Rehab - Hot Mix Recycling				
Depth of Cold Milling of Existing Surface	2	1	Ins.	Plans
Percent Recycled Asphaltic Pavement in Overlay Mix	2	15	%	MISTIC
Type of Cold Mill Machine	3	Up Cut		Const.
Overlay Paving Equipment	3			
2) AC Rehab - AC Overlay				
Number of Binder Lifts	2	2	Each	Plans
Lift 1 Binder Thickness	3	1.50	In.	Plans
Date Lift 1 Binder Completed	3	7/82		Const.
Lift 2 Binder Thickness	3	1.25	In.	Plans
Date Lift 2 Binder Completed	3	7/82		Const.
Surface Thickness	3	1.25	In.	Plans
Date Surface Completed	3	8/82		Const.
3) AC Rehab - Cold, In-Place, Recycling				
Depth of Recycling	2	2	In.	Plans
Type of Cold Mill Machine	3	CMI		Const.
Type of Rejuvenator	3			Const.
Source of Rejuvenator	3			MISTIC
Type of Paving Machine	3			Const.

III. PROJECT DESIGN (Continued)

B) Rehabilitation Design (Continued)

Data Element	Level	Example	Units	Data Source
Direction of Cutting Drum	3	Down		Const.
Rejuvenator Application Rate	3	.85-1.0	% Residual By Weight	MISTIC
"Big D" of Mix	3	2.47		MISTIC
Sealed/Overlaid	3	No		Const.
4) AC Rehab - Heater Scarification & Overlay				
Depth of Scarification	2	.75	In.	Plans
Type of Equipment Used	2			Const.
Type of Asphalt Modifier	3			MISTIC
Asphalt Modifier Supplier	3			MISTIC
Virgin Asphalt Surface Mix Application Rate	3	70	Lbs/sy	Const.
Method of Applying Virgin Material	3	Mix with HST Material		Const.
5) AC Rehab - Cold Mill Only				
Depth of Cold Milling	2	.75	In.	Const.
Width of Cutting Drum	3	12	Ft.	Const.
Diameter of Cutting Drum	3	28	In.	Const.
Type of Cold Mill Machine	3	Up Cut		Const.
Speed of Cold Mill Machine	3	45	Ft/min	Const.
Type of Cutting Teeth	3	GTE AM 722		Const.
Ave. Number of Tooth Striations in Longitudinal Direction	3	18	Per 20 Ft.	Const.
Ave. Number of Tooth Striations	3	1.7	In.	Const.
Ave. Number of Rows of Tooth Striations in Transverse Direction	3	87	Per 5 Ft.	Const.
6) AC Rehab - Crack Sealing				
Type of Sealant	3	HFE 90		MISTIC
Type of Cover Chips	3	CA-16		Const.
Type of Reservoir	3	Sawed		Const.
7) PCC Rehab - Crack and Seat				
Pavement Breaker Type	3	Whip Hammer		Const.
Average PCC Breakage Size	3	3	Ft.	Const.
Reinforcement Cut or Broken	3	No Not Likely		Const.
Seating Roller Type	3	Pneumatic		Const.
Seating Roller Weight	3	35	Tons	Const.