URMS: A Graphical Urban Roadway Management System at Network Level

XIN CHEN, JOSE WEISSMANN, TERRY DOSSEY, AND W. RONALD HUDSON

A graphical urban roadway management system (URMS) is described. The objective of the system is to assist in scheduling maintenance and rehabilitation (M&R) projects at the network level. URMS works in graphics mode and is characterized by simplicity, flexibility, and user-friendliness. In URMS, management sections can be composed of one or more street blocks. Pavement condition index, which is derived from seven types of distress, is the main calculation variable used in the system. Other evaluation indexes include pavement age, mixed average daily traffic, and truck average daily traffic. The assignment of M&R strategy to each section is performed by means of a decision tree. A methodology combining two matrices and an equation is used for project prioritization. Users can change distress types, M&R strategies, and parameters of all the models. The entire system, including the data base and all models and graphics, is written in Turbo Pascal with the Borland Graphics Interface. The system was tested and its functionality demonstrated with the use of data from the city of Austin, Texas.

Pavement management systems (PMSs) have gained popularity in the transportation industry as tools to help managers and engineers make decisions for managing pavements (*1*). Considerable effort is now under way at state and local government levels for developing and implementing PMSs (*2–6*). It has been shown that implementing properly designed and developed PMSs improves not only the efficiency but also the effectiveness of decision making involved in managing pavements (*7,8*).

The successful implementation of a PMS depends mainly on three factors: reliable data, realistic models for processing the data, and user-friendly software for organizing the inputs and presenting the outputs. In general, the more relevant information on pavement condition collected, the better PMS performance will be. Much of the information needed for supporting a complex PMS is costly to collect, particularly for cities in which expensive equipment such as devices for measuring pavement deflection, roughness, and friction are not available. Adopting simple and consistent PMS practices in the initial phase of PMS implementation is recommended for medium-size urban pavement networks where a complex system is not justified (*4*). Unlike pavement thickness design programs, which are based on proven algorithms and scientific facts, a PMS for selecting cost-effective maintenance and rehabilitation (M&R) projects at the network level is very much dependent on local policy and engineering judgment.

Since the development of PMS software is time-consuming and expensive, it is desirable that the resulting software be flexible in such a way that it can be easily tailored to local policies of the agency that will finally use it. Flexible PMS computer programs that allow users to change some of the data items and parameters of models or to select user-defined models are desirable (*8*) and may significantly reduce the cost of developing and implementing PMSs by extending the applicability of the product to many agencies. User-friendly PMS software is also important in the implementation phase. Good PMS programs should be easy to use and easy to learn. The application of graphical user interface technology greatly improves the user-friendliness of PMS software (*6,7*).

Geographic information system (GIS) technology has also been applied to pavement management (*7*); However, because of the high costs and the time and effort to implement it for pavement management (*6*), its applicability is restricted to medium and large cities.

Under the auspices of the Energy Research Application Program sponsored by the state of Texas, research toward the development of a comprehensive urban roadway management system (URMS) is under way. The main objective of the URMS project is to develop a comprehensive PMS for managing urban pavements effectively; the focus is to save energy in terms of roadway user operating costs and pavement M&R costs. The complete system covers M&R planning at the network level and pavement design, construction, and maintenance at the project level.

Described in this paper is the pilot program, the first part of the URMS: M&R scheduling at the network level. The objective of this initial part of the system is to schedule cost-effective M&R projects at the network level. The system is designed to work in graphics mode on any IBM personal computer (or compatible) with a VGA monitor. Figure 1 shows the overall structure of the system. Basically, it is com-

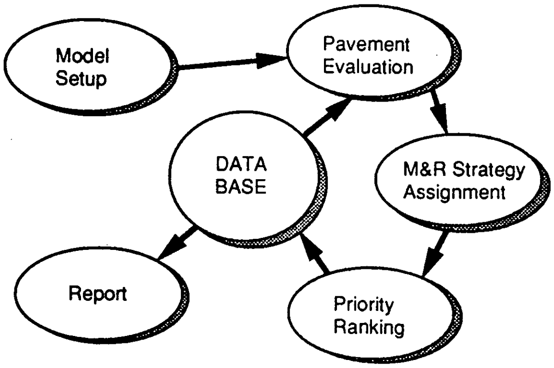


FIGURE 1 Data flow chart.

Center for Transportation Research, ECJ 6.10, University of Texas, Austin, Tex. 78712.

posed of a data base module, a pavement evaluation module, a M&R selection module, and a reporting module. In the URMS, management sections are identified by one or more blocks. Pavement condition index (PCI), which is derived from seven distress types for either flexible or rigid pavements is the main condition variable used in the program. Other condition variables include pavement age (AGE), mixed average daily traffic (MADT), and truck average daily traffic (TADT). A decision tree that takes PCI, AGE, and TADT into account is used for assigning M&R strategy for each section. Two priority ranking matrices and a priority rating equation are combined for M&R project prioritization. The data base and all models and graphics are combined into an integrated program. The system was tested with sample data from the city of Austin, Texas.

DATA BASE MODULE

Thirty-nine data items are used in the subsystem. Some data items can be shared by the design, construction, and maintenance subsystems. Data can be classified into

- Basic data: the minimum required data for running the program,
- Street map data: street map *x-y* coordinate data, and
- Distress data: percentage of distress in terms of distress type and severity.

Basic data covers section code, street name, location from, location to, pavement type (flexible or rigid pavement), section length, number of traffic lanes, pavement width (total width of traffic lanes), construction year, last major rehabilitation year (medium overlay, thick overlay, or reconstruction), average daily traffic (ADT), traffic growth rate, percentage of trucks, and PCI.

Street map data are optional and distress data can also be optional if PCI is available from an external computer file that has been calculated using some other model defined by the user. The street map data cover pavement section "location from" and "location to" *x-y* coordinates. The seven default distress types used in the PCI calculations are

- For flexible pavements: alligator cracking, block cracking, longitudinal and transverse cracking, rutting, bleeding/polishing, raveling/pothole, and patching.
- For rigid pavements: linear cracking, D-cracking, polishing, faulting, spalling, corner break, and patching.

Again, these distress types can be changed by users, if desired.

In the URMS computer program, management sections can be one block to several blocks long. The section code consists of a letter and six digits. The letter can be "A" for arterial street, "C" for collect, or "L" for local. The rest of the code consists of street and block sequence numbers that can be defined by the user.

All the information for one management section can be displayed on one screen as shown in Figure 2. The section is

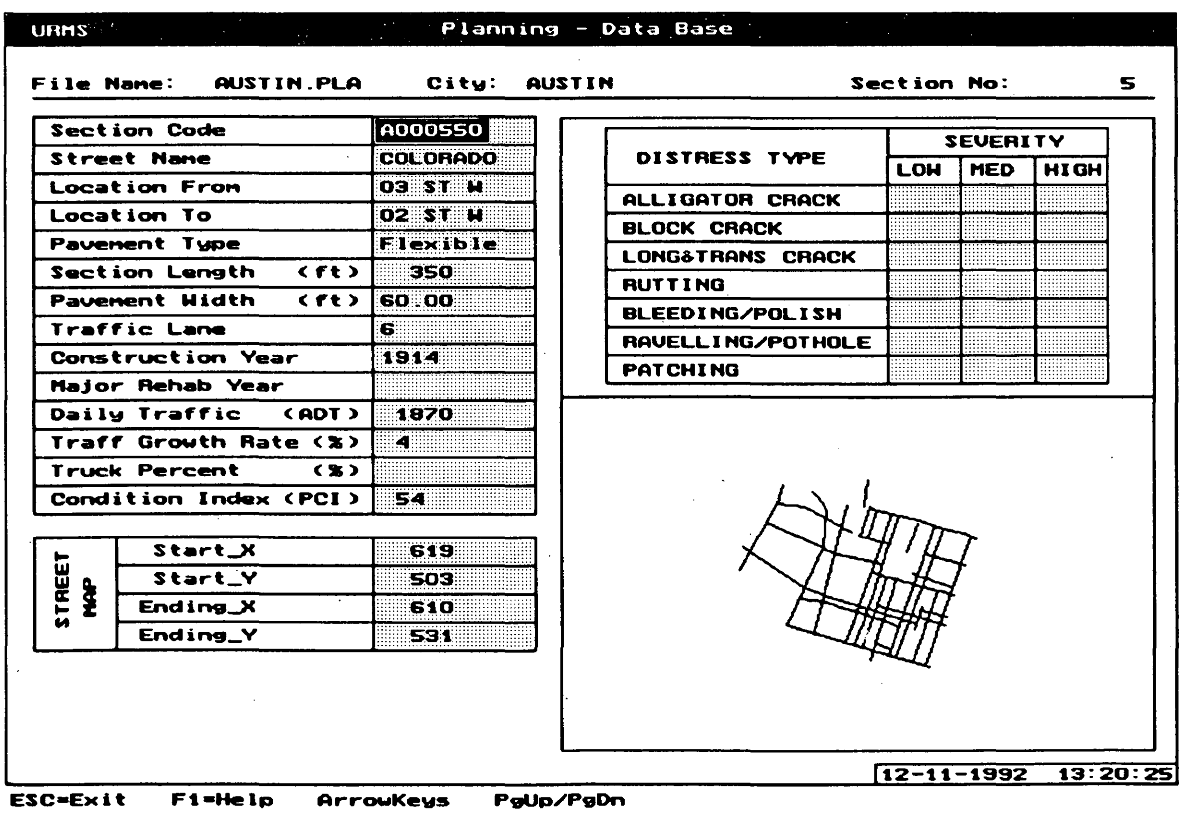


FIGURE 2 Data input and edit screen.

highlighted in the street map in the lower right box. Figure 3 shows 20 sections (records) on one screen (PT = pavement type, LEN = section length in feet, W = pavement width in feet, YEAR = construction year, r = traffic growth rate, $\%T$ = percentage of truck). The bottom box shows PCI and ADT in scale, the numbers being the last two digits of the first column that are used to find the records. The data base handling capabilities integrated into the URMS include many functions such as editing, sorting, and searching.

EVALUATION MODULE

Three types of evaluation index—PCI, pavement age index, and traffic index—are included in the URMS. PCI is a function of pavement distress type, severity, and density. The following equation is used to compute PCI:

$$PCI = 100 - \sum_i \sum_j W_{ij} \times D_{ij} \qquad (1)$$

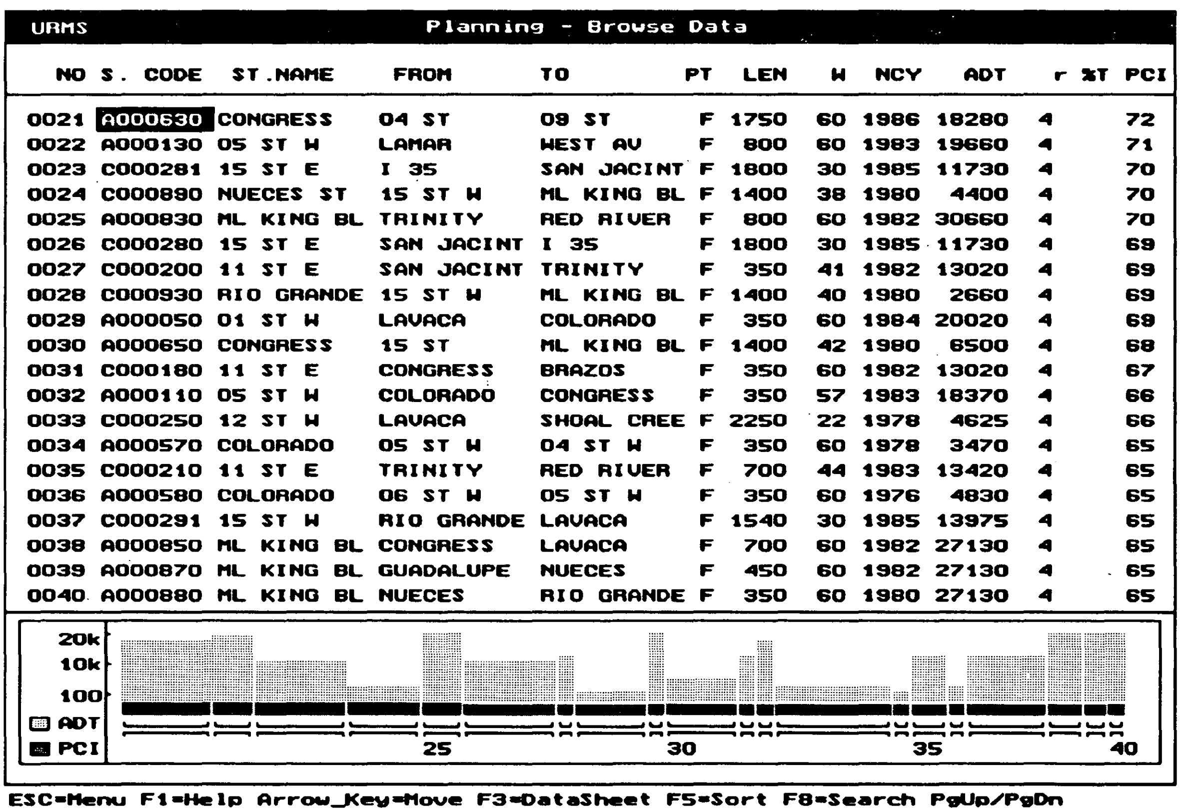
where W_{ij} is the weight of distress type i and severity type j, and D_{ij} is the percentage of area of distress type i and severity type j. Distress weights (range from 0 to 1) reflect the relative contribution of the distress type and severity to PCI. In general, they are determined by engineering judgment. The default values are set for the first use of the system; users can change both the distress types and weights to suit local conditions.

Pavement age is defined as the time from the year of new construction to the year of the distress survey. Because the total service lives of flexible and rigid pavements are quite different, pavement ages for the two types of pavement are calculated separately. All the evaluation indexes are divided into five classes, as shown in Figure 4. The limiting values for all the evaluations shown are default values (MADT and TADT in vehicles per lane per day), which can also be changed by the user.

Figure 5 shows the main screen of the output for the evaluation module. The left box presents the section results one by one. Detailed information of each section can also be presented at the same time using a function key. In Figure 5, the two boxes to the right present the summary evaluation results for the whole network in terms of PCI, AGE, MADT, and TADT. The lower right bar chart shows the PCI distribution. A street map that shows the distribution of pavement or traffic condition can also be drawn at this point.

M&R PROGRAM MODULE

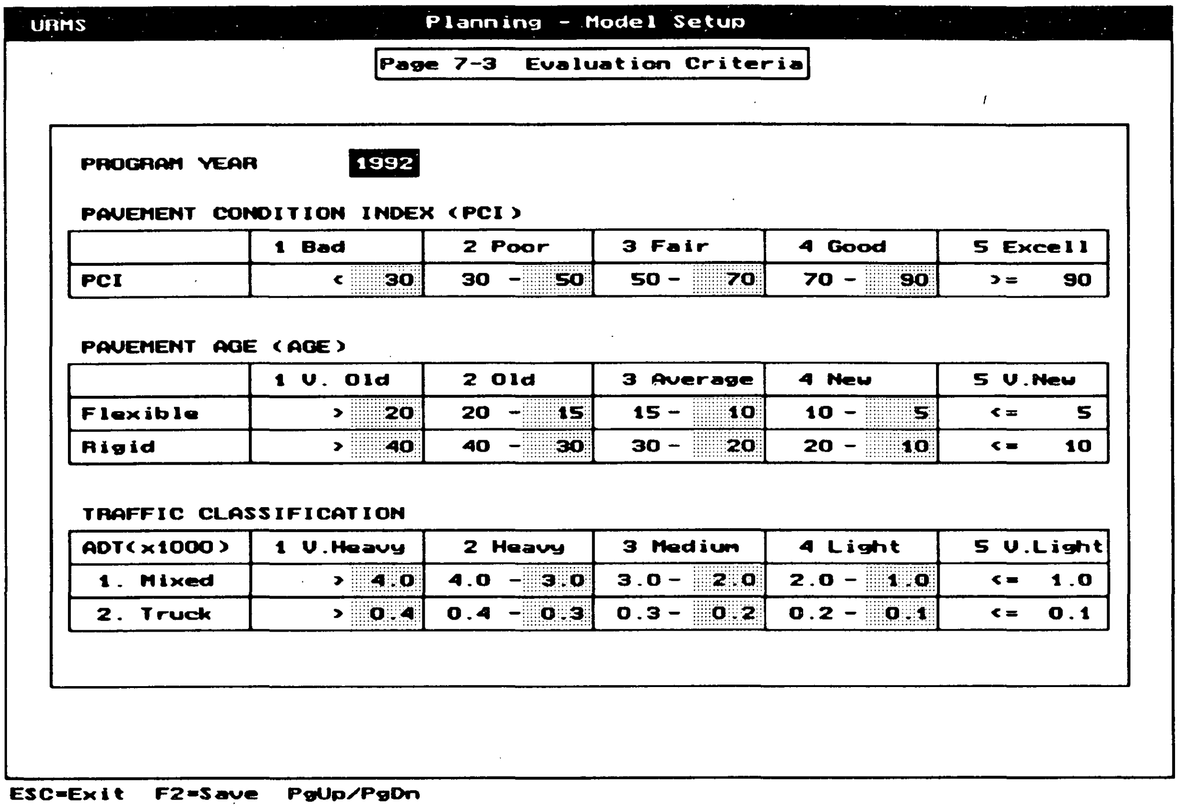
In this pilot program, two simple models—M&R strategy assignment and priority ranking model—are combined for selecting M&R projects. First, each section is assigned an M&R strategy by the decision tree model based on the evaluation results. There are two decision trees in the URMS: one for flexible pavements and another for rigid pavements. Figure 6 shows the decision tree for flexible pavements. If



URMS Planning - Browse Data

NO	S. CODE	ST.NAME	FROM	TO	PT	LEN	W	NCY	ADT	r	%T	PCI
0021	A000630	CONGRESS	04 ST	09 ST	F	1750	60	1986	18280	4		72
0022	A000130	05 ST W	LAMAR	WEST AV	F	800	60	1983	19660	4		71
0023	C000281	15 ST E	I 35	SAN JACINT	F	1800	30	1985	11730	4		70
0024	C000890	NUECES ST	15 ST W	ML KING BL	F	1400	38	1980	4400	4		70
0025	A000830	ML KING BL	TRINITY	RED RIVER	F	800	60	1982	30660	4		70
0026	C000280	15 ST E	SAN JACINT	I 35	F	1800	30	1985	11730	4		69
0027	C000200	11 ST E	SAN JACINT	TRINITY	F	350	41	1982	13020	4		69
0028	C000930	RIO GRANDE	15 ST W	ML KING BL	F	1400	40	1980	2660	4		69
0029	A000050	01 ST W	LAVACA	COLORADO	F	350	60	1984	20020	4		69
0030	A000650	CONGRESS	15 ST	ML KING BL	F	1400	42	1980	6500	4		68
0031	C000180	11 ST E	CONGRESS	BRAZOS	F	350	60	1982	13020	4		67
0032	A000110	05 ST W	COLORADO	CONGRESS	F	350	57	1983	18370	4		66
0033	C000250	12 ST W	LAVACA	SHOAL CREE	F	2250	22	1978	4625	4		66
0034	A000570	COLORADO	05 ST W	04 ST W	F	350	60	1978	3470	4		65
0035	C000210	11 ST E	TRINITY	RED RIVER	F	700	44	1983	13420	4		65
0036	A000580	COLORADO	06 ST W	05 ST W	F	350	60	1976	4830	4		65
0037	C000291	15 ST W	RIO GRANDE	LAVACA	F	1540	30	1985	13975	4		65
0038	A000850	ML KING BL	CONGRESS	LAVACA	F	700	60	1982	27130	4		65
0039	A000870	ML KING BL	GUADALUPE	NUECES	F	450	60	1982	27130	4		65
0040	A000880	ML KING BL	NUECES	RIO GRANDE	F	350	60	1980	27130	4		65

FIGURE 3 Browse data screen.



URMS Planning - Model Setup

Page 7-3 Evaluation Criteria

PROGRAM YEAR 1992

PAVEMENT CONDITION INDEX (PCI)

	1 Bad	2 Poor	3 Fair	4 Good	5 Excell
PCI	< 30	30 - 50	50 - 70	70 - 90	>= 90

PAVEMENT AGE (AGE)

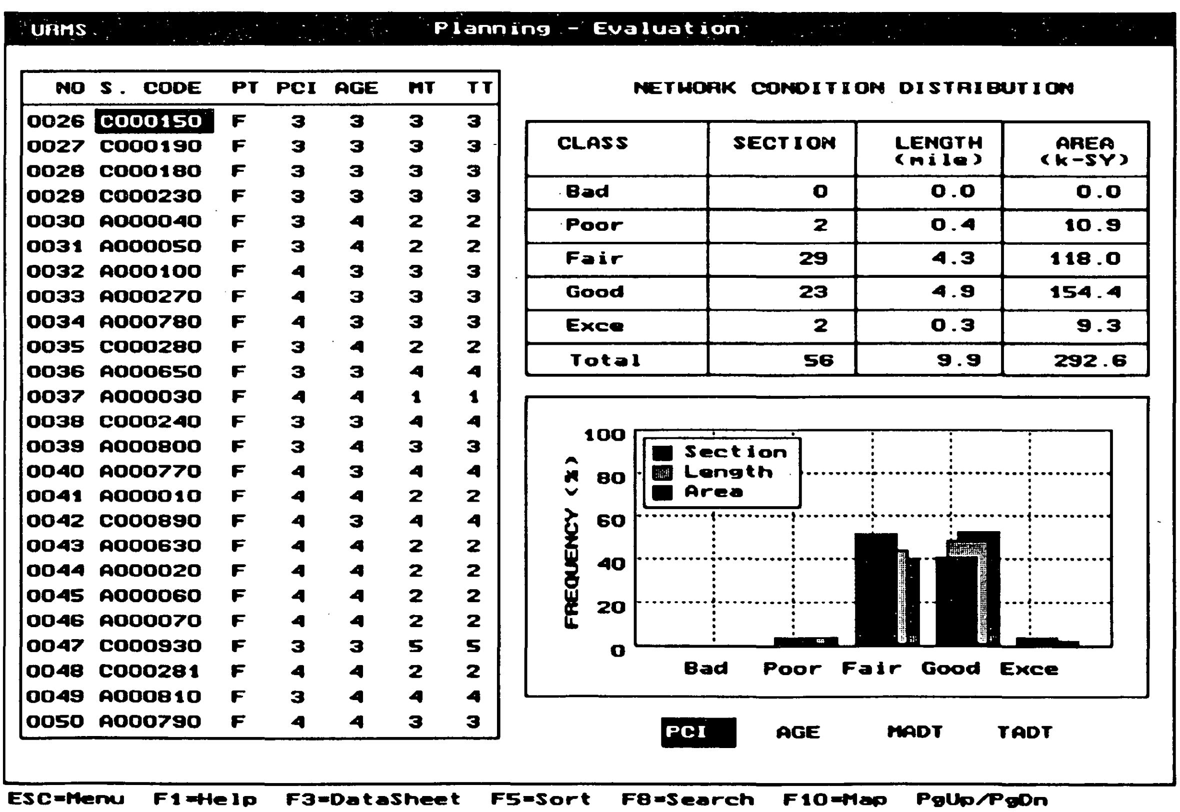
	1 V. Old	2 Old	3 Average	4 New	5 V.New
Flexible	> 20	20 - 15	15 - 10	10 - 5	<= 5
Rigid	> 40	40 - 30	30 - 20	20 - 10	<= 10

TRAFFIC CLASSIFICATION

ADT(x1000)	1 V.Heavy	2 Heavy	3 Medium	4 Light	5 V.Light
1. Mixed	> 4.0	4.0 - 3.0	3.0 - 2.0	2.0 - 1.0	<= 1.0
2. Truck	> 0.4	0.4 - 0.3	0.3 - 0.2	0.2 - 0.1	<= 0.1

ESC=Exit F2=Save PgUp/PgDn

FIGURE 4 Evaluation criteria screen.



URMS Planning - Evaluation

NO	S. CODE	PT	PCI	AGE	MT	TT
0026	C000150	F	3	3	3	3
0027	C000190	F	3	3	3	3
0028	C000180	F	3	3	3	3
0029	C000230	F	3	3	3	3
0030	A000040	F	3	4	2	2
0031	A000050	F	3	4	2	2
0032	A000100	F	4	3	3	3
0033	A000270	F	4	3	3	3
0034	A000780	F	4	3	3	3
0035	C000280	F	3	4	2	2
0036	A000650	F	3	3	4	4
0037	A000030	F	4	4	1	1
0038	C000240	F	3	3	4	4
0039	A000800	F	3	4	3	3
0040	A000770	F	4	3	4	4
0041	A000010	F	4	4	2	2
0042	C000890	F	4	3	4	4
0043	A000630	F	4	4	2	2
0044	A000020	F	4	4	2	2
0045	A000060	F	4	4	2	2
0046	A000070	F	4	4	2	2
0047	C000930	F	3	3	5	5
0048	C000281	F	4	4	2	2
0049	A000810	F	3	4	4	4
0050	A000790	F	4	4	3	3

NETWORK CONDITION DISTRIBUTION

CLASS	SECTION	LENGTH (mile)	AREA (k-SY)
Bad	0	0.0	0.0
Poor	2	0.4	10.9
Fair	29	4.3	118.0
Good	23	4.9	154.4
Exce	2	0.3	9.3
Total	56	9.9	292.6

FIGURE 5 Evaluation main screen.

the total required M&R cost is greater than the available budget, prioritization is performed. In the decision tree, PCI, AGE, and TADT are taken into account. Up to 18 types of M&R strategies can be defined by the user. The default types for flexible pavements are

- Do nothing,
- Routine maintenance,
- Thin overlay,
- Medium overlay,
- Thick overlay, and
- Reconstruction.

For the sake of simplicity, the five classes of each variable are further combined into two or three groups. Users can group them by changing the variable codes, as illustrated in Figure 6.

The prioritization procedure can be conducted using one or more variables. Basically, there are two ways to construct a priority ranking model if multiple variables are to be considered: the matrix method and the equation method. A more flexible way, which combines two matrices and an equation for computing the priority index (PIX), is presented in Figure 7. As shown in the figure, PIX is a function of the PCI, pavement age, mixed traffic, and street class. Any of the four variables can be ignored by setting one or more of the parameters to 0. For example, street class and traffic variables can be eliminated by changing the weight of 30 to 0 in the equation. Street class will also not be taken into account if each row number is the same in the right matrix. By analyzing the information in Figure 7, it can be implied that the smaller the PIX, the higher the priority for that section.

The URMS currently determines an annual M&R program. It can be improved to determine multiyear M&R program with the inclusion of pavement deterioration models. It currently can approximate M&R programs for up to 5 years on the basis of the PIX approach as discussed. The basic idea of the approximation is that sections of higher priority will be scheduled for M&R earlier than those of lower priority. If some noncontiguous short sections are selected by the program, these sections can be combined manually.

The main output screen for the M&R module is shown in the background of Figure 8. In Figure 8 the last four columns present the basic outputs M&R strategy (S), PIX, recommended action year (RAY), and M&R cost in thousands of dollars, for each section. Figure 8 also presents the summary information of the recommended M&R program that covers the total M&R needs, including the recommended number of M&R sections and required M&R budgets. The M&R information for each section can also be summarized in bar charts and presented in a street map with different colors.

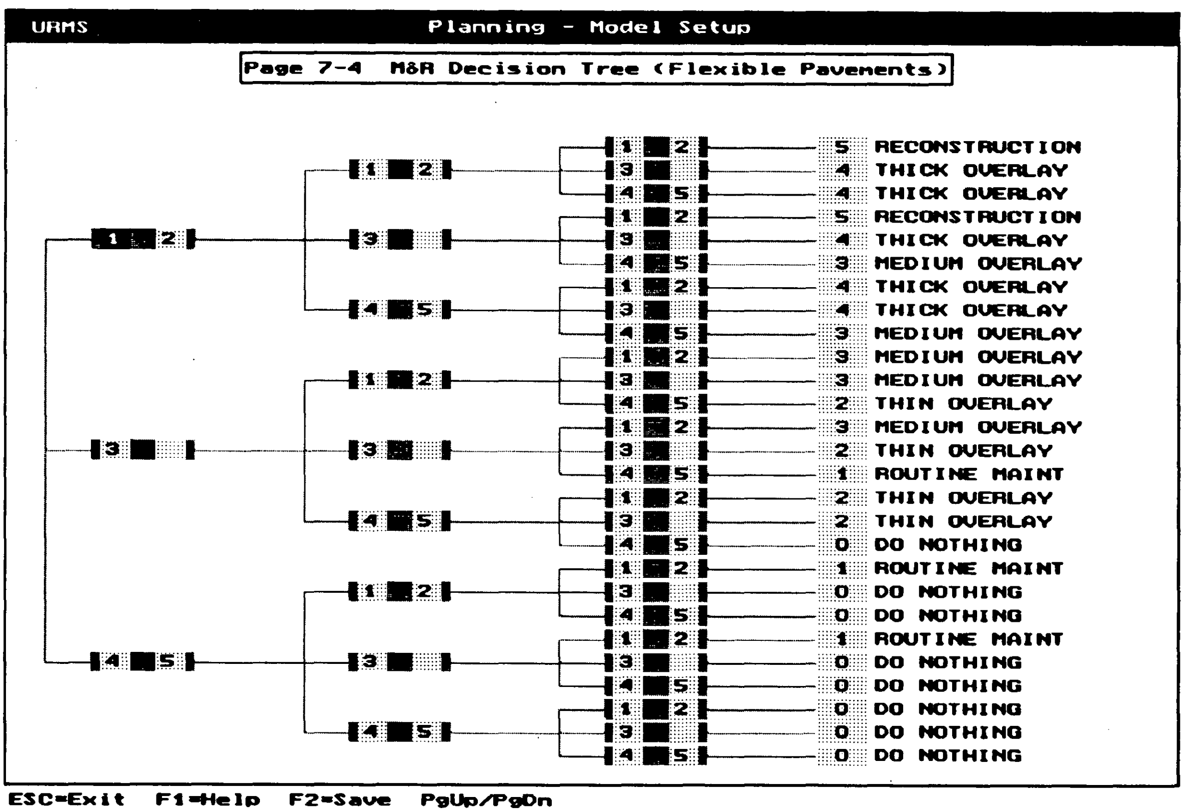


FIGURE 6 M&R strategy assignment decision tree screen.

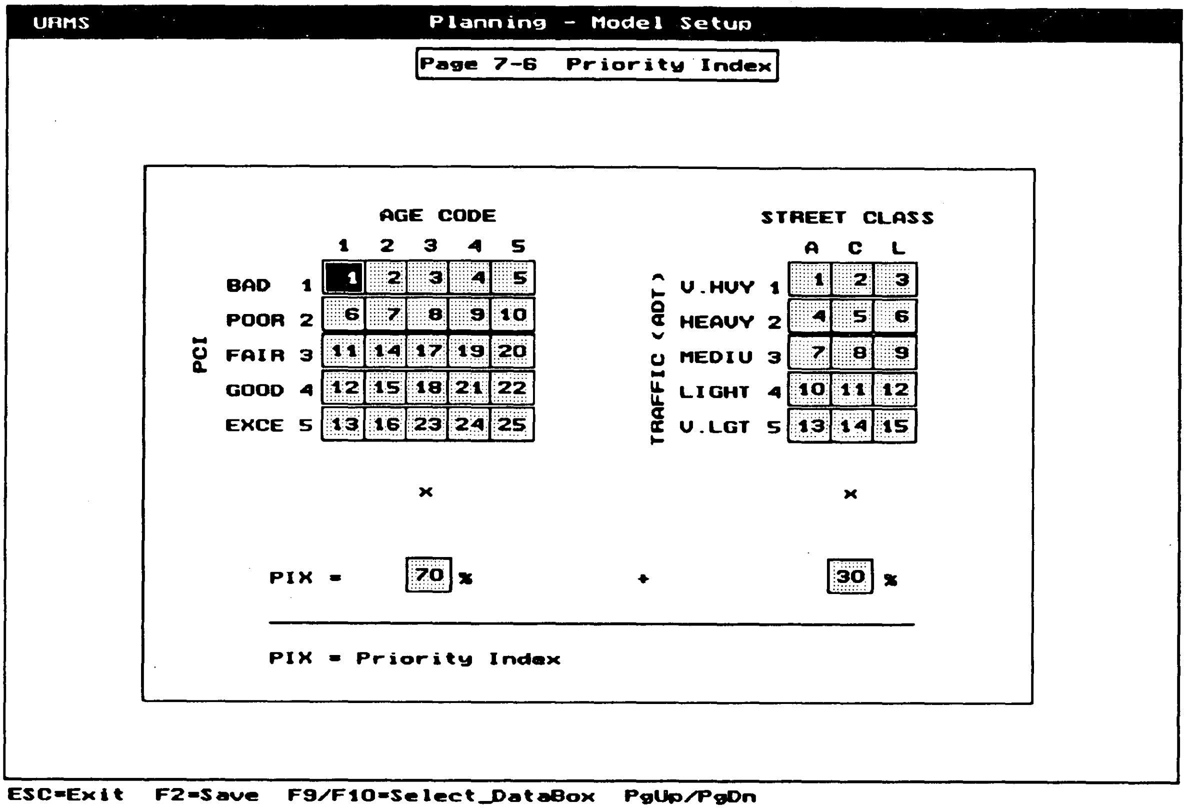


FIGURE 7 PIX screen.

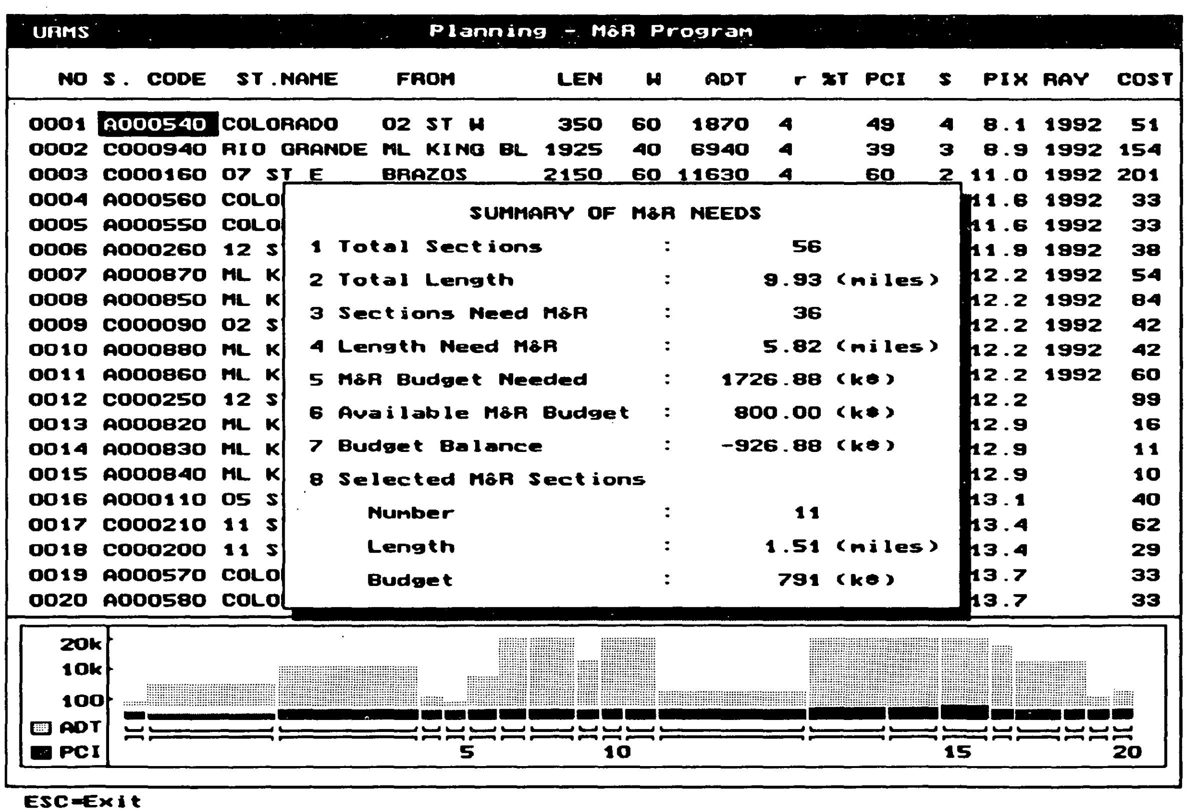


FIGURE 8 M&R program screen.

REPORT MODULE

URMS can generate seven types of report: four types are listings, and three types are summaries. Listing reports include

1. Basic input and output information,
2. Recommended M&R projects,
3. Pavement distress data, and
4. Street map *x-y* coordinates.

Summary reports include

1. Street functional classes and pavement types,
2. Pavement condition and traffic evaluation, and
3. M&R needs and recommended M&R projects.

Figures 9 through 11 present three sample reports. Basic input and output information for 35 sections are listed in Figure 9. Figure 10 presents the summary evaluation infor-

URBAN ROADWAY MANAGEMENT SYSTEM (URMS V.1.0) Report No: 7 - 1
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LISTING OF BASIC INPUT AND OUTPUT INFORMATION

Input File: AUSTIN.PLA Report Date: 12-11-1992 Page: 1

NO	SECTION CODE	STREET NAME	LOCATION FORM	LOCATION TO	TYPE	LENGTH (ft)	WIDTH ft	TRAF LN	CONSTRU YEAR	LASTRB YR	TRAFFIC ADT	RATE %	TRUC %	PCI	M&R	P INDEX	ACTION YEAR	M&R COST K$
00001	A000540	COLORADO	02 ST W	01 ST W	F	350	60	6	1914		1870	4		49	4	8.1	1992	51.3
00002	C000940	RIO GRANDE	ML KING BL	24 ST W	F	1925	40	4	1980		6940	4		39	3	8.9	1992	154.0
00003	C000160	07 ST E	BRAZOS	I 35	F	2150	60	6	1928		11630	4		60	2	11.0	1992	200.7
00004	A000560	COLORADO	04 ST W	03 ST W	F	350	60	6	1914		3470	4		58	2	11.6	1992	32.7
00005	A000550	COLORADO	03 ST W	02 ST W	F	350	60	6	1914		1870	4		54	2	11.6	1992	32.7
00006	A000260	12 ST W	SHOAL CREE	LAMAR	F	475	40	4	1978		9250	4		63	3	11.9	1992	38.0
00007	A000850	ML KING BL	CONGRESS	LAVACA	F	700	60	6	1982		27130	4		65	3	12.2	1992	84.0
00008	A000880	ML KING BL	NUECES	RIO GRANDE	F	350	60	6	1980		27130	4		65	3	12.2	1992	42.0
00009	C000090	02 ST E	BRAZOS	CONGRESS	F	350	60	6	1978		13860	4		50	3	12.2	1992	42.0
00010	A000860	ML KING BL	LAVACA	GUADALUPE	F	500	60	6	1982		27130	4		60	3	12.2	1992	60.0
00011	A000870	ML KING BL	GUADALUPE	NUECES	F	450	60	6	1982		27130	4		65	3	12.2	1992	54.0
00012	C000250	12 ST W	LAVACA	SHOAL CREE	F	2250	22	2	1978		4625	4		66	3	12.2		99.0
00013	A000820	ML KING BL	CONGRESS	TRINITY	F	1200	60	6	1982		30660	4		74	1	12.9		16.0
00014	A000840	ML KING BL	RED RIVER	I 35	F	750	60	6	1982		30730	4		88	1	12.9		10.0
00015	A000830	ML KING BL	TRINITY	RED RIVER	F	800	60	6	1982		30660	4		70	1	12.9		10.7
00016	A000110	05 ST W	COLORADO	CONGRESS	F	350	57	6	1983		18370	4		66	3	13.1		39.9
00017	C000210	11 ST E	TRINITY	RED RIVER	F	700	44	4	1983		13420	4		65	3	13.4		61.6
00018	C000200	11 ST E	SAN JACINT	TRINITY	F	350	41	4	1982		13020	4		69	3	13.4		28.7
00019	A000580	COLORADO	06 ST W	05 ST W	F	350	60	6	1976		4830	4		65	2	13.7		32.7
00020	A000570	COLORADO	05 ST W	04 ST W	F	350	60	6	1978		3470	4		65	2	13.7		32.7
00021	A000130	05 ST W	LAMAR	WEST AV	F	800	60	6	1983		19660	4		71	1	13.8		10.7
00022	A000120	05 ST W	WEST AV	COLORADO	F	2650	56	6	1983		18370	4		75	1	13.8		33.0
00023	C000290	15 ST W	LAVACA	RIO GRANDE	F	1540	30	3	1985		13975	4		63	2	13.9		71.9
00024	C000291	15 ST W	RIO GRANDE	LAVACA	F	1540	30	3	1985		13975	4		65	2	13.9		71.9
00025	C000220	11 ST E	RED RIVER	I 35	F	700	44	4	1982		13420	4		77	1	14.1		6.8
00026	C000190	11 ST E	BRAZOS	SAN JACINT	F	350	60	6	1982		13020	4		60	2	14.3		32.7
00027	C000230	11 ST W	CONGRESS	COLORADO	F	350	60	6	1982		12030	4		61	2	14.3		32.7
00028	C000150	07 ST E	CONGRESS	BRAZOS	F	350	55	5	1983		11220	4		61	2	14.3		29.9
00029	C000180	11 ST E	CONGRESS	BRAZOS	F	350	60	6	1982		13020	4		67	2	14.3		32.7
00030	A000040	01 ST W	COLORADO	CONGRESS	F	350	60	6	1984		19800	4		64	2	14.5		32.7
00031	A000050	01 ST W	LAVACA	COLORADO	F	350	60	6	1984		20020	4		69	2	14.5		32.7
00032	A000780	LAVACA ST	04 ST W	11 ST W	F	2450	60	6	1980		16790	4		77	0	14.7		
00033	A000270	12 ST W	LAMAR	WEST LYNN	F	2750	44	4	1980		9250	4		75	0	14.7		
00034	A000100	05 ST E	SAN JACINT	CONGRESS	F	700	57	6	1983		14180	4		80	0	14.7		
00035	C000280	15 ST E	SAN JACINT	I 35	F	1800	30	3	1985		11730	4		69	2	14.8		84.0

Pavement Type: F = Flexible Pavement R = Rigid Pavement
Flexible Pavement M&R Strategy
0=DO NOTHING 1=ROUTINE MAINT 2=THIN OVERLAY 3=MEDIUM OVERLAY 4=THICK OVERLAY
5=RECONSTRUCTION
Rigid Pavement M&R Strategy
0=DO NOTHING 1=ROUTINE MAINT 2=THIN AC OVERLAY 3=MEDIUM AC OVERLAY 4=THICK AC OVERLAY

City: AUSTIN User: University of Texas Analyst: Chen

FIGURE 9 Sample listing printout.

URBAN ROADWAY MANAGEMENT SYSTEM (URMS V.1.0) Report No: 7 - 6

SUMMARY OF PAVEMENT CONDITION AND TRAFFIC EVALUATION (1991)

Input File: AUSTIN.PLA Report Date: 12-11-1993

CONDITION CODE	CLASS DESCRIPTION	LIMITING VALUE	SECTION NUMBER	%	LENGTH MILES	%	AREA 1000 SY	%
* PCI								
1	Bad	<= 30	0	0.0	0.0	0.0	0.0	0.0
2	Poor	30 - 50	2	3.6	0.4	4.3	10.9	3.7
3	Fair	50 - 70	29	51.8	4.3	43.8	118.0	40.3
4	Good	70 - 90	23	41.1	4.9	49.2	154.4	52.8
5	Exce	> 90	2	3.6	0.3	2.7	9.3	3.2
* AGE								
1	V.Old	> 20(40)	4	7.1	0.6	6.1	21.3	7.3
2	Old	15(30) - 20(40)	5	8.9	0.7	7.2	14.6	5.0
3	Fair	10(20) - 15(30)	26	46.4	4.8	48.6	146.4	50.0
4	New	5(10) - 10(20)	21	37.5	3.8	38.1	110.3	37.7
5	V.New	<= 5(10)	0	0.0	0.0	0.0	0.0	0.0
* MADT								
1	V.Hvy	> 4000	10	17.9	1.6	16.4	46.1	15.8
2	Heavy	3000 - 4000	17	30.4	3.1	30.7	91.0	31.1
3	Mediu	2000 - 3000	12	21.4	2.2	22.4	62.6	21.4
4	Light	1000 - 2000	9	16.1	2.1	21.1	63.3	21.6
5	V.Lgt	<= 1000	8	14.3	0.9	9.3	29.6	10.1
* TADT								
1	V.Hvy	> 400	10	17.9	1.6	16.4	46.1	15.8
2	Heavy	300 - 400	17	30.4	3.1	30.7	91.0	31.1
3	Mediu	200 - 300	12	21.4	2.2	22.4	62.6	21.4
4	Light	100 - 200	9	16.1	2.1	21.1	63.3	21.6
5	V.Lgt	<= 100	8	14.3	0.9	9.3	29.6	10.1
	TOTAL		56	100.0	9.9	100.0	292.6	100.0

City: Demonstration User: University of Texas Analyst: Chen

FIGURE 10 Pavement evaluation summary printout.

mation of pavement condition and traffic. Two types of M&R summary are given in Figure 11. One presents the summary of M&R needs and another shows the recommended M&R sections for the analysis period. In this example 36 flexible pavement sections require maintenance or rehabilitation at a cost of $1.73 million; but only $0.8 million is available. Because of the shortage of funds, only 11 pavement sections are selected for maintenance or rehabilitation out of the 36 candidate sections.

CONCLUSIONS

A graphical URMS was described in this paper. The system was written in Turbo Pascal and is designed for scheduling cost-effective M&R projects at the network level. The functionality of the system was tested with sample data from Austin, Texas. The system is characterized by

- Simplicity: the system uses reduced pavement data, all basic data can be collected easily. It includes simple models that can be easily understood and used.
- Flexibility: users can change some of the data items and all the model parameters.
- User-friendliness: all the input and output are conveniently organized through the use of a graphical interface. Online help is provided and the system is easy to learn and use.

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URBAN ROADWAY MANAGEMENT SYSTEM (URMS V.1.0) Report No: 7 - 7

SUMMARY OF MAINTENANCE & REHABILITATION PROGRAM
Flexible Pavements

1. Maintenance & Rehabilitation Needs

Input File: AUSTIN.PLA Report Date: 12-11-1992

M&R STRATEGY Code	Description	UNIT COST ($/SY)	SECTION Number	%	LENGTH (mile)	%	BUDGET $1000	%
0	DO NOTHING	0.00	20	35.7	4.11	41.4	0.00	0.0
1	ROUTINE MAINT	2.00	9	16.1	1.97	19.8	122.00	7.1
2	THIN OVERLAY	14.00	15	26.8	2.19	22.1	850.34	49.2
3	MEDIUM OVERLAY	18.00	11	19.6	1.59	16.0	703.20	40.7
4	THICK OVERLAY	22.00	1	1.8	0.07	0.7	51.33	3.0
5	RECONSTRUCTION	45.00	0	0.0	0.00	0.0	0.00	0.0
	TOTAL		56	100.0	9.93	100.0	1726.9	100.0

2. Recommended M & R projects for 1992

Input File: AUSTIN.PLA Report Date: 12-11-1992

M&R STRATEGY Code	Description	UNIT COST ($/SY)	SECTION Number	%	LENGTH (mile)	%	BUDGET $1000	%
0	DO NOTHING	0.00	45	80.4	8.43	84.8	0.00	0.0
1	ROUTINE MAINT	2.00	0	0.0	0.00	0.0	0.00	0.0
2	THIN OVERLAY	14.00	3	5.4	0.54	5.4	266.00	33.6
3	MEDIUM OVERLAY	18.00	7	12.5	0.90	9.1	474.00	59.9
4	THICK OVERLAY	22.00	1	1.8	0.07	0.7	51.33	6.5
5	RECONSTRUCTION	45.00	0	0.0	0.00	0.0	0.00	0.0
	TOTAL		56	100.0	9.93	100.0	791.3	100.0

City: AUSTIN User: University of Texas Analyst: Chen

FIGURE 11 M&R program summary printout.

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