Approach to Maintenance Management

L. C. JONES, Bureau of Street Maintenance, Department of Public Works, City of Los Angeles

The Bureau of Street Maintenance is one of twelve Bureaus which make up the Department of Public Works of the City of Los Angeles. The Bureau is responsible for four major functions which are assigned to four functional divisions:

Street Maintenance Division

Cleaning, repairing, resurfacing, minor reconstructing and remodeling, trench replacing, structural maintenance, and other maintenance activities.

Street Tree Division

1. Trimming, maintaining, regulating of planting, and supervising and administering tree contracts.
2. Maintaining lawns and other plantings in approximately 90 acres of traffic islands.

Lot Cleaning Division

1. Cleaning lots and removing weeds at least once a year on approximately 30,000 parcels of vacant property.
2. Removing brush in hilly areas, along roadsides, and adjacent to improved properties, as requested by the Los Angeles Fire Department.

Street Use Inspection Division

1. Regulating the use of streets and other public ways for any and all purposes other than normal pedestrian and vehicular traffic, including the following: (a) utility substructures, excavation, and backfill; (b) storing of building materials; (c) transportation of overloads and housemoving; (d) banners over streets, advertising benches in public ways, etc.; and (e) serving of notices to repair curbs, sidewalks, driveways, etc.
2. This division is also the enforcement arm of the Department of Public Works.

In addition to the four functional divisions, we have an Equipment and Supply Division which is a service organization that purchases and maintains equipment and supplies for all functional Divisions.

The city encompasses an area of 463.60 square miles, with elevation ranging from below sea level to 5,074 feet. Its street system consists of 7,275 miles of streets and public ways, with grades from practically 0 to 33 percent. It also includes shoestring strips which connect sections of the city. Other areas completely surround incorporated and unincorporated areas. From the northern-most to southern-most points of the city, the distance is 55 miles. It has areas which are changing in character, including the San Fernando Valley which comprises about 40 percent of the city and is rapidly changing from areas comprised of orange groves and agricultural cultivation to fairly dense urban areas. Narrow dirt roads are becoming wide-paved boulevards. The city has a total population of 2,896,100 and a very heavy vehicle registration.

The Bureau of Street Maintenance has a complement of approximately 2300 regular Civil Service employees, a budget for the current fiscal year of over $27 million, and an equipment fleet of approximately 1900 units. The city has two zone divisions, with three maintenance areas in each zone, and four maintenance districts in each area.

In speaking of the Bureau's approach to maintenance management, one could select at random any of a number of our operations. However, I shall confine the subject to a particular aspect of our work, the application of industrial engineering principles to the work of the Street Maintenance Division.

The program had its beginning in 1960 when it was suggested that the Director of the Bureau discuss a possible contract agreement with a consulting firm to undertake

a survey of our operations. We were not impressed with this idea; our reaction was that this would be just another survey, and we had undergone many surveys in the past ten years. You might even say that we had surveys of surveys, and all by reputable firms. Our experience was that these firms would come in with their staff, study our operation, publish a report detailing the problems that had been described to them by members of our own staff, and depart. Normally, the approach was always the same, with very little original work on their part. They provided the report and you were then on your own. Therefore, when we were approached with this proposal, we were something less than enthusiastic. However, as this firm explained their program, we recognized that theirs was a fresh approach. They offered to practically live in the Bureau, selecting and then training our employees in the techniques of the work, implementing the work, and then staying on for a period of several months to guarantee that the system they had developed was sound, properly installed, and working. Since the proposed system had never been applied to street maintenance operations, we were still cautious and, instead of buying the entire proposal advanced, only a portion of the program was selected.

This, then, was the start of the application of industrial engineering principles to a considerable portion of the work of the Street Maintenance Division. The first activity of the consulting firm was to select, by special examination, a group of methods and standards technicians composed of our own employees. This appears to us to have been one of the keys to the success of this program. The selection of technicians was made impartially and objectively as the result of a battery of tests supplied and conducted by the consultants and with no interference from management. Following the selection and training, the methods and standards section was activated and work started. There followed a period of 17 weeks of study during which they scientifically analyzed the work assigned to the crews, the work assigned to each man in each crew, and each essential movement of every man in the crew. They then measured and tabulated the enforced delays, or the waiting time, when only one operation can be performed at a given time, and the balance of the crew must wait. Figure 1 is a typical illustration of the studies that were made of crew sizes. Note particularly the "idle time," or enforced delays, which are so prominent in the three- and four-man crews, as compared to the comparatively small amount of such time in the two-man crew.

Figure 2 summarizes the delays (Fig. 1). Note the difference in crew costs per day and the delay cost per day for each crew size. The lower section, relates the crew costs to the cost per individual job.

Following this study, they were ready with charts to prove their points and to present their first recommendation—that 21 four-man crews be reduced to two-man crews. This recommendation was, as anticipated, immediately questioned to varying degrees by many of the supervisors.

After a number of discussions, consultations, and deliberations, the first of a series of crew size recommendations was adopted. The crew sizes were reduced by attrition. A total of 149 maintenance laborer positions were eliminated from a total of 472 employees initially placed under time standards. In conjunction with attrition, there was an upgrading of 32 field positions. With the establishment of two-man crews, it was necessary that one man be in charge and responsible for the paper work, so a special code of crew leader was established, which provided a premium of $1.20 per day for this responsibility.

The reduction of crew sizes is not the sole purpose of a trained staff methods and standards section. Using methods and procedures developed by this staff section, the hours reported by the crew for daily and job site preparation; travel to job sites, asphalt plants, dumps; and return to district yards is compared against a time standard which has been engineered for that or those jobs.

Figure 3 is a typical sample of one of the source documents, showing the miles traveled, material used, locations, and type and amount of work done by a two-man small bituminous repair crew.

Figure 4 shows the standards technician's recap of the crew for a typical day's work. This is the reverse side of the daily work sheet shown in Figure 3. Note that

the workman has an example to follow. The actual performance received by the crew for the work recorded is 74 percent.

The weekly performance for each crew is calculated. Thus, although the crews and work in our City cannot be under constant supervision, a form of control has been established and is being extended gradually to all crews engaged in street maintenance work on a city-wide basis.

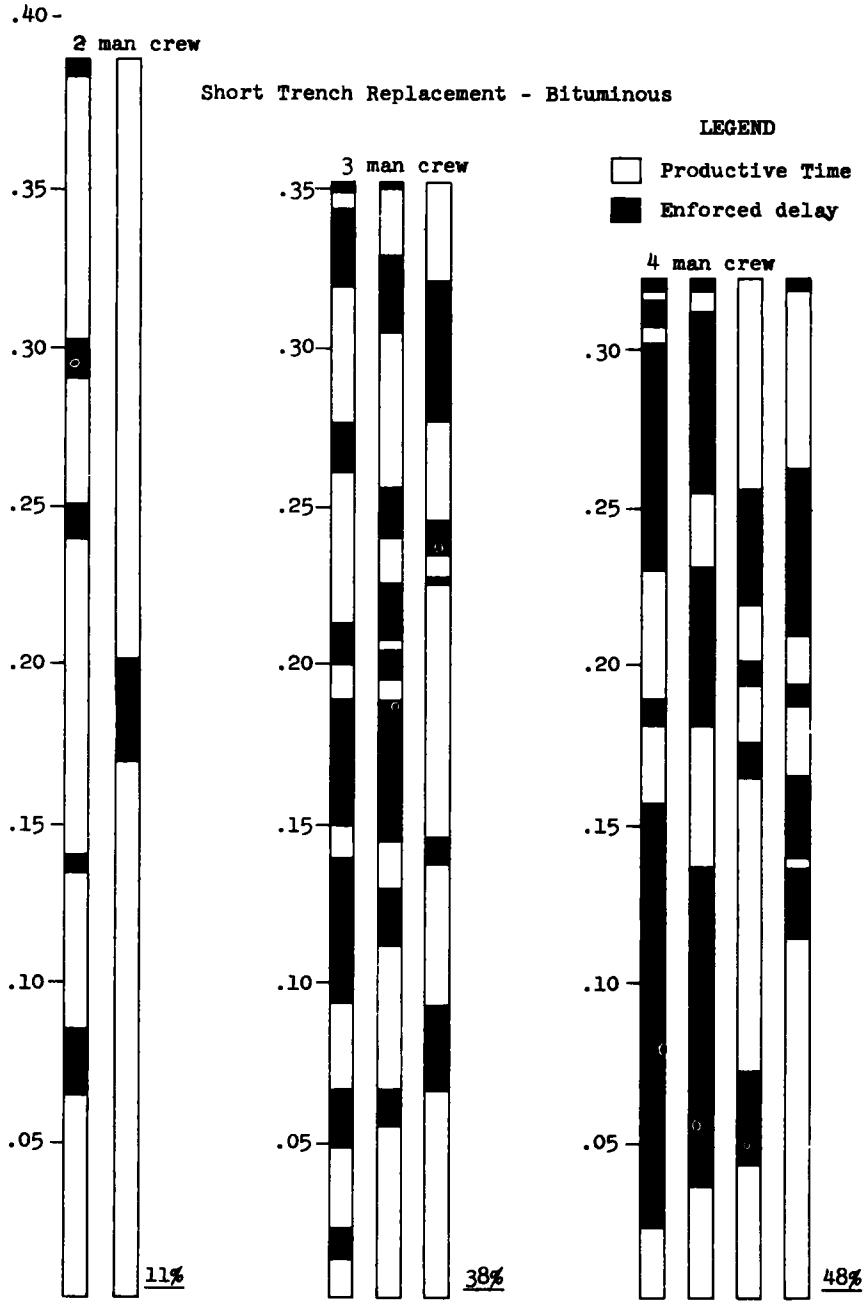

Figure 1. Engineered comparison of different sized crews performing the same operation.

COMPARISON OF DIRECT LABOR COST AND DELAY COST FOR VARIOUS CREW SIZES

CREW SIZE	CREW SIZE PER DAY	DELAY AT_____%	DELAY COST PER DAY
4	$87 04	48	$41 78
3	$66 72	38	$25 35
2	$46 40	11	$5 10

TYPICAL TRENCH (12 SQUARE FEET)

CREW SIZE	ELAPSED HOURS PER TRENCH	MAN HOURS PER TRENCH	DIRECT COST PER TRENCH
4	0 3225	1 2900	$3 51
3	0 3525	1 0575	$2 94
2	0 3900	0 7800	$2 26

Figure 2. Short trench replacement—bituminous.

This methods and standards section is also used to evaluate new equipment, to compare our methods and procedures with other organizations in similar work, and to suggest crew reassignments due to work backlogs in the various areas and districts. This section prepares and distributes management reports in graph form to all management levels concerning crew performances, hours utilized, and current work backlogs.

Figure 5 is a typical backlog of work report, showing the volume of trench replacing work in Zone I, on April 12, 1968, together with crews assigned, etc.

Figure 6 is a composite report depicting the function of "bituminous short trench" showing utilization of personnel on the assigned function, backlog in crew days of bituminous trenches and, most important, crew performance at that time, as rated by the standards technician. This report is placed in each respective district yard for review by the crew and the district foreman. Composite reports reflecting all crews doing this work and other types of work are compiled for the Director of the Bureau, and for four lower levels of supervision and/or management.

Decisions involving shifting of crews, budgetary needs, requests to meet workload requirements, and many other needs are simplified with this type of current information.

Subsequent to this initial program, additional installations have been made in other departments and bureaus of the City of Los Angeles: Department of Recreation and Parks, Department of Traffic, Bureau of Sanitation, and Bureau of Transportation.

This Bureau entered into a second contract with the same management firm to extend management control coverage to the Equipment and Supply Division. Mechanical repair standards were developed for the following:

1. Heavy-duty equipment: (a) graders, (b) skiploaders, (c) gradalls, etc.
2. Trucks (dumps, flushers, sweepers, etc.), and standards were developed to extend coverage for: (a) tire repair section, (b) auto electricians section, (c) sweeper broom shop section, (d) lubrication and preventive maintenance section, (e) machine shop section, and (f) engine rebuild section.

During fiscal year 1967-68, a third contract between the Bureau of Street Mainteance and the same consulting firm was signed to extend coverage to the resurfacing and special projects section of the Street Maintenance Division. In this third installation, a different approach from either of the first two was employed. At this time, we felt that our methods and standards section personnel were adequately trained to undertake the study, and a similar procedure was followed whereby the new technicians were sent to school for MTM training. Therefore, the management consulting firm was hired for guidance purposes only. In essence, the company made a survey and presented their findings in a programmed plan for controlling the installation.

The resurfacing and special projects section is composed of 351 employees. This section has the responsibility of the resurfacing and minor reconstruction of all streets, the repair of all bridges and tunnels, the operation of two municipal asphalt plants, and the necessary transportation of materials. We know that the elimination of positions from this section will not be as great as the initial installation because, following the initial study, several supervisors took their cue and immediately started to reduce crew sizes. However, we do feel that additional reductions will be made.

Crew Leader fill out and return to Foreman at end of each work day.

DAILY WORK SHEET
SMALL BITUMINCUS REPAIR

Speedometer Reading:

End of Day 45500

Beginning of Day 45450

Mileage for Day 50

Truck Number

Number of emergencies or radio calls (if) 2

Date 12-1-67

District No. 07

Function No.

Crew Members	#44	#	#
1. Jones	Hours 8		
2. Smith	8		

Dump Site Used Washington

Plant Used P. #2

Material Drawn 4 Tons

LOCATION	E	SKIN PATCH			DIG OUT & REPLACE	DEPTH
Ethel and Oak		x	x	x	3 x 3	4'
Fulton and Elm		6 x 10	4 x 4	1 x 1	x	
		1 x 1	1 x 1	1 x 1	x	
		3 x 10	x	x	x	
Orchard and 90th St.		1 x 1	2 x 15	4 x 10	x	
Gaunt and Valerie		2 x 2	2 x 2	2 x 2	x	
		2 x 2	6 x 8	x	x	
11406 Vesper		x	x	x	3 x 2	5"
		x	x	x	4 x 2	5"
Dayton and Elm		7 x 2	6 x 5	5 x 5	x	
Lemon and Noble		4 x 10	3 x 9	4 x 10	1 x 1	4"
		x	x	x	1 x 1	4'
		x	x	x	x	
		x	x	x	x	
		x	x	x	x	
		x	x	x	x	
		x	x	x	x	
		x	x	x	x	

Crew Leader's Remarks and Other Work Section on reverse side.

M&S 240.11
R4 5/16/68

Figure 3.

Additional studies are contemplated, primarily along the lines of our third contract, Our next proposal will include the street cleaning operation, with other sections and divisions to follow.

To date, the installation of this MTM program within the Bureau has produced a net labor savings of $4,339,344. The savings due to increased production has been difficult to ascertain, due to the type of work. However, all crews are using from 25 to 100 percent more bituminous or concrete materials than prior to 1962. One indication of savings that occurred unexpectedly in the third year of management control was that

Crew Leader's Remarks: _____

_____

_____

_____

_____

For Use by Standards Technician

Total Miles Driven	50	Daily Earned Travel
Minimum Miles Allowed	30	2.60
Patrol Miles	20	

1. Craft Hours for Skin Patch 5.09
2. Craft Hours for Dig Out & Replace. 1.06
3. Other Work 10
4. Dump Delay Hours(0.20/dump). 20
5. Daily Prep. (0.88) & Plant Delay (0.66). . . 1.54
6. Site Preparation / Site 7 x .08 56
7. Total Craft Hours 8.55

E X A M P L E

LOCATION	E	SKIN PATCH			DIG OUT & REPLACE	DEPTH
Lemon Ave. & Noble		4 x 10	3 x 9	6 x 7	2 x 1	5"
Fulton & Elm		6 x 10	4 x 4	x	3 x 2	5"
11406 Dayton Ave.		3 x 30	x	x		
90th St. & Orchard		x	x	x	4 x 1	4"
Gaunt & Valerie		2 x 2	2 x 2	6 x 8	x	
3907 Ethyl St.		2 x 16	x	x	1 x 3	4"
3823 Ethyl St.		3 x 6	2 x 18	x	x	
3753 Ethyl St.		5 x 7	x	x	4 x 3	4"
3720 Ethyl St.		3 x 31	2 x 2	x	x	

Figure 4.

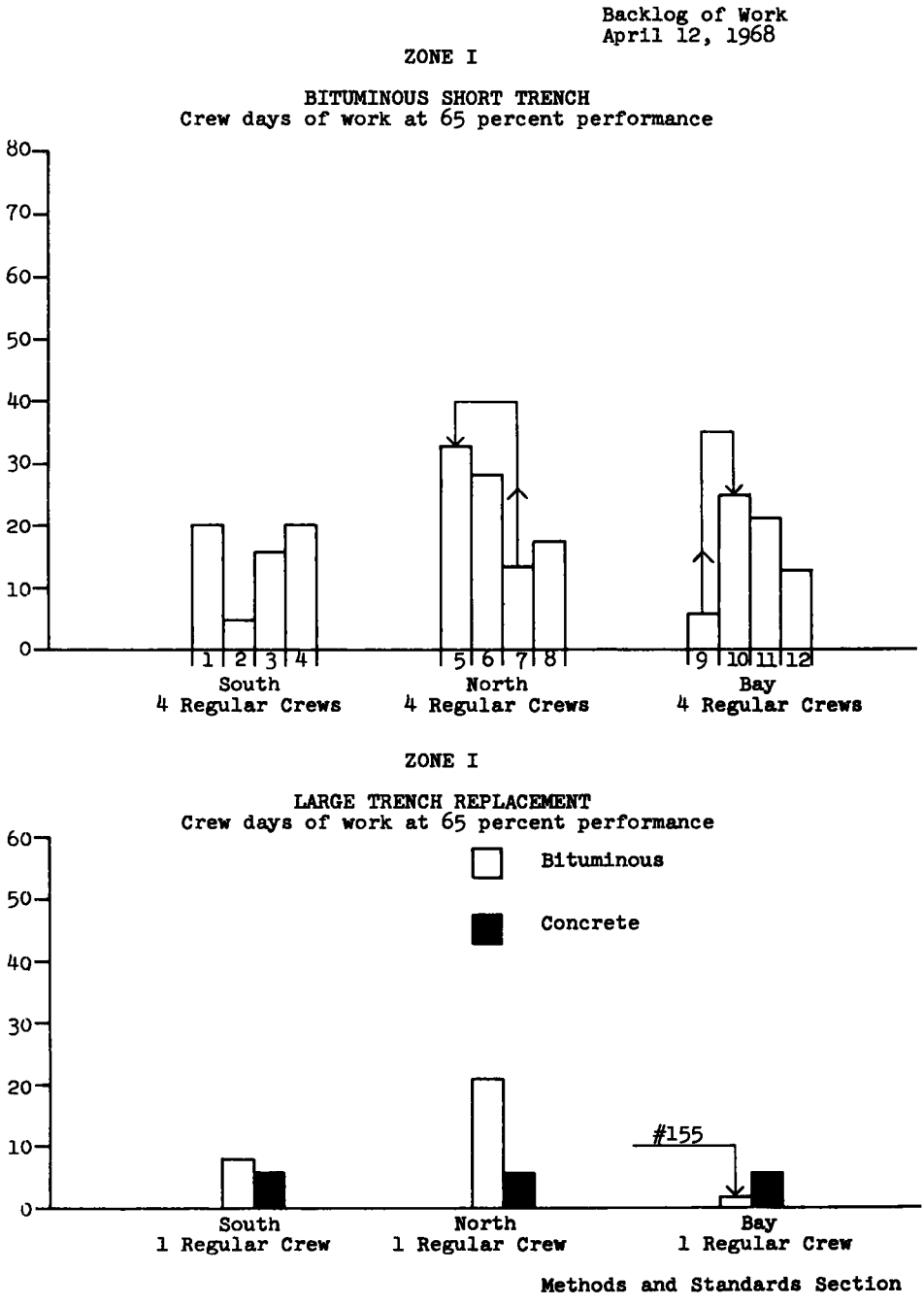
Backlog of Work
April 12, 1968
ZONE I
BITUMINOUS SHORT TRENCH
Crew days of work at 65 percent performance
80
70
60
50
40
30
20
10
0
1 2 3 4
South
4 Regular Crews
5 6 7 8
North
4 Regular Crews
9 10 11 12
Bay
4 Regular Crews
ZONE I
LARGE TRENCH REPLACEMENT
Crew days of work at 65 percent performance
Bituminous
Concrete
60
50
40
30
20
10
0
#155
South
1 Regular Crew
North
1 Regular Crew
Bay
1 Regular Crew
Methods and Standards Section

Figure 5.

the Bureau purchased $23,000 less gasoline, due to the emphasis placed on minimum travel miles. This reduction in equipment mileage would also result in longer equipment life. The second installation in the Equipment and Supply Division has resulted in a net labor savings of $316,841.

Both installations have shown sizable savings; in addition, crews have been provided with engineered standards, and management has been furnished with improved controls and yardsticks by which the Bureau can operate more effectively and with improved efficiency.

I realize that I have described a large operation, and that the amount of dollars saved may not be possible in some cities, but the points I hope you will keep in mind are these:

1. It pays to analyze the work of your crews scientifically, and in minute detail, both as to size of crew and every detail of their work. A considerable saving may be realized.

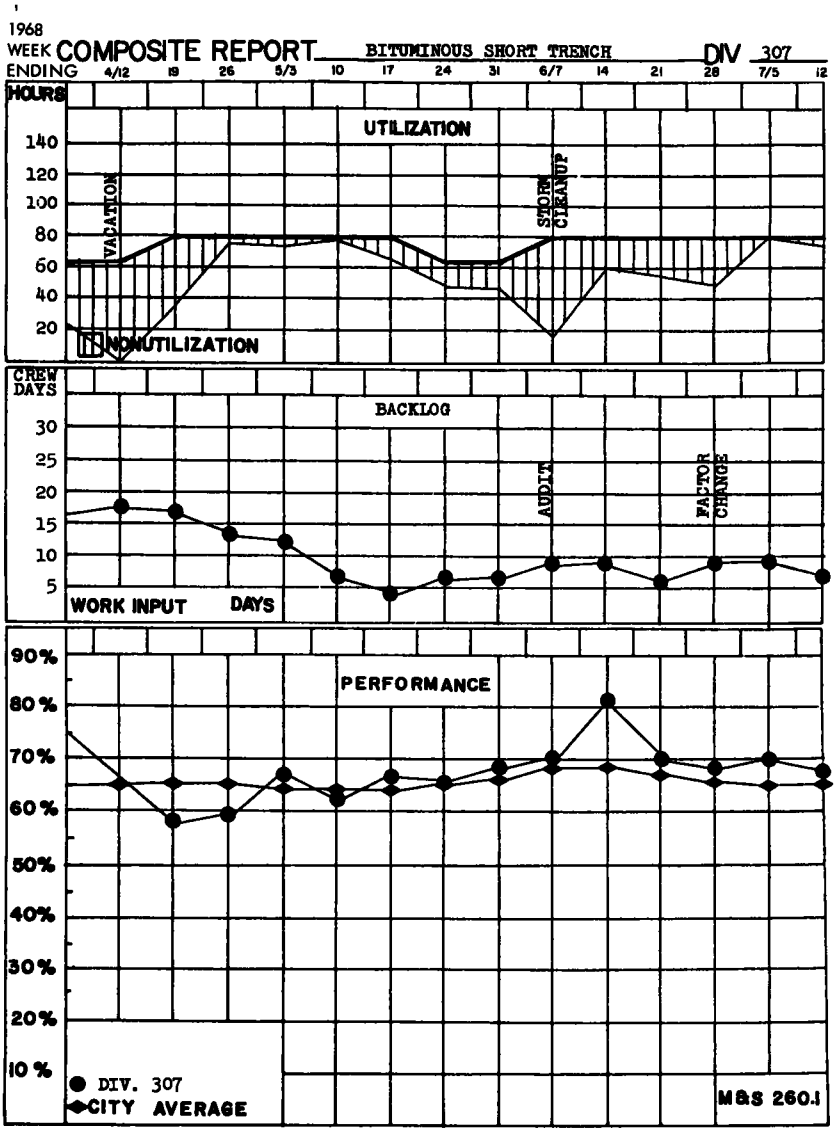

Figure 6.

2. For this type of installation, it pays to train your employees who know the work, and who cannot be misled or fooled, to do this kind of work. There is no substitute for actual on-the-job experience, regardless of formal education, in street maintenance and construction work.

3. By its very nature, our work is not easy to control, but it can be controlled by establishing engineered work standards and scheduling the work of the crews so they are working against time standards as much as possible.

4. Properly-trained, methods and standards technicians can be very valuable administrative assets, and can relieve administration of many problems, headaches, and pressures.

5. The reaction of some of you will probably be along this line—"Los Angeles has lots of money—can afford this type of study and installation, etc.—but my operations do not justify or lend themselves to this type of program." I can only say that all street maintenance work is similar because this work involves movement, motions, and enforced delays; and the potential savings and improvements are so great that the size of your crews and their work methods and procedures deserve study in depth.