

STAFFING OPTIONS FOR MAINTENANCE

Stanley P. Smalley, Roy Jorgensen Associates, Inc.

•TRADITIONALLY, the size of a maintenance staff for a highway maintenance organization has been based on a combination of the following factors: miles or lane-miles of highway, past experience, number of trucks and graders, and typical organizational charts.

With the introduction of maintenance management systems, various options are now available to the maintenance manager as to how to staff to accomplish a planned maintenance workload. Before we discuss the various staffing options that are available, we should review how a maintenance management system workload is developed.

DEVELOPMENT OF ANNUAL WORK PROGRAM

The input requirements for development of an annual work program are summarized as follows:

1. Work Activities—The defining of maintenance work activities, establishing units for work measurement, and classification of roads by maintenance characteristics.
2. Maintenance Feature Inventory—The conduct and compilation of an inventory of the maintenance features or characteristics on the highway system which relate to the defined maintenance activities.
3. Standards—The development of standards for each road class defining level of service, determining average annual quantities of work needed, establishing standard methods and procedures for work performance, and establishing expected rates of accomplishment.

Figure 1 is an example of the computations to determine the annual man-hours required for two maintenance activities. For activity "reshaping gravel surface" the inventory unit on which the work load is based is gravel road miles. The management unit in the example calculation has 97 gravel road miles. The average annual quantity of work needed to maintain the gravel roads properly was determined to be 10 gradings per year, which multiplied by the inventory of 97 miles results in an annual work quantity of 970 road miles of grading for this particular management unit. The expected average daily production for a standard crew size as set forth in the performance standard is 10 miles of grading. Dividing the 970 miles to be graded by the 10 miles graded per day results in a 97-crew-day requirement. The performance standard also specifies a 2-man crew size. Therefore, the 97 crew days times the 2-man crew size times 8 man-hours per man per day results in an annual requirement of 1,552 man-hours of "reshaping gravel surface" for this particular management unit. The same type of calculation is also shown for activity "pothole patching." The total man-hour requirements for any management unit would be the summation of the individual activities.

WORKLOAD DISTRIBUTION

In the development and analysis of the maintenance workload, each activity is classified as either fixed, semifixed, or variable.

Fixed maintenance work activities are ones which because of temperature (such as seal coating), seasonal (such as mowing), or functional (such as overhead) considerations must be performed during specific times or periods of the year.

Semifixed activities are those which must be performed during a certain period of the year but can be shifted within the months as required for workload leveling. Examples of activities in this category include cleaning roadside ditches, full-width litter pickup, and recondition gravel roads.

MANAGEMENT UNIT: DISTRICT 1
 PREPARED BY: MAC
 DATE: 11/20/70

Column 1	Column 2	Col.3 (X)	Col.4 (=)	Col.5 (±)	Col.6 (=)	Col.7 (X)	Col.8 (X8)	Col.9
ACTIVITY DESCRIPTION	INVENTORY UNIT	NUMBER INVENTORY UNITS	ANNUAL QUANTITY/INVENTORY UNIT	ANNUAL WORK QUANTITY	AVERAGE DAILY PRODUCTION	CREW DAYS	CREW SIZE	TOTAL MAN-HOURS
Reshaping Gravel Surface	Gravel Road Miles	97	10 miles	970	10 miles	97	2	1552
Pothole Patching	Bituminous 2-lane Mile	30	2.0 Tons	60	3.0 Tons	20	3	480

Figure 1. Annual maintenance program manpower computation summary.

Variable activities are those which because of the absence of general constraints can be performed virtually anytime during the year. Included in this group are such activities as tree removal and clearing brush.

By distributing the man-hours associated with the fixed, semifixed, and variable activities in accordance with the respective constraints and with an objective of building as level a workload as possible, manpower requirements are determined.

Figure 2 shows for a county in Michigan the resulting manpower requirements as determined by the accumulation of needs for fixed, semifixed, and variable activities.

STAFFING OPTIONS

With manpower requirements varying from a high of 87 men in September to a low of 51 in February as shown in Figure 2, what is the proper staff necessary to accomplish the defined workload? Various options are available to the maintenance manager and are discussed in the following pages of this paper.

Staffing Option I

A permanent staff of 87 men, as shown in Figure 3, can be used to accomplish the workload. Table 1 gives the resource requirements of a permanent 87-man staff. The defined workload equals 132,766 man-hours and is budgeted in the amount of \$2,433,332. A nonmaintenance capacity of 27,314 man-hours is generated by the 87-man staff during the months of January through May and October through December. The additional capacity would require \$179,097 for labor and overhead expenses. One major problem of the generated nonmaintenance capacity is to find work that can be performed during the winter months. If work can be found and if it is the type of work of which labor would account for approximately 40 percent of the total cost, then an additional \$161,000 would be required for equipment and materials cost. Therefore, a total of approximately \$341,000 would be required in addition to the maintenance performance budget to utilize the nonmaintenance capacity generated by an 87-man permanent staff.

Staffing Option II

By creating an accentuated summer peak that can be performed by summer hires, a permanent staff of 76 men and 18 summer hires can accomplish the workload as shown

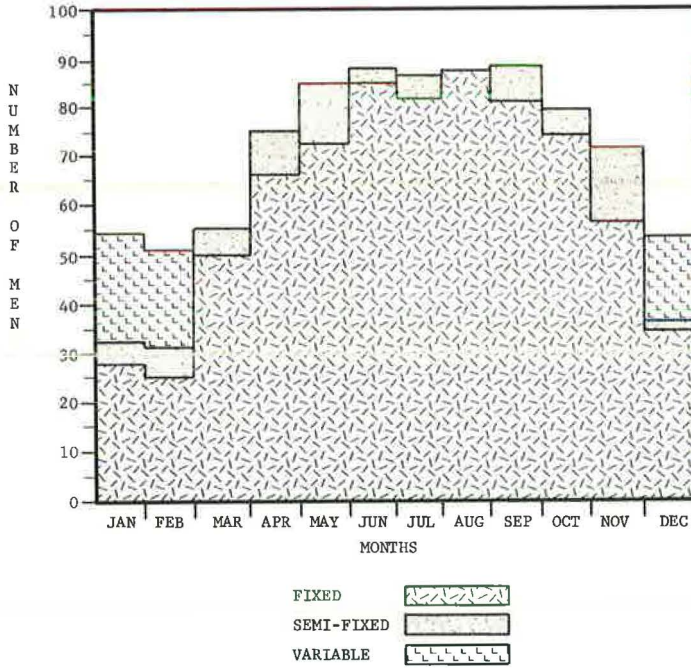


Figure 2. Manpower requirements for a county maintenance workload.

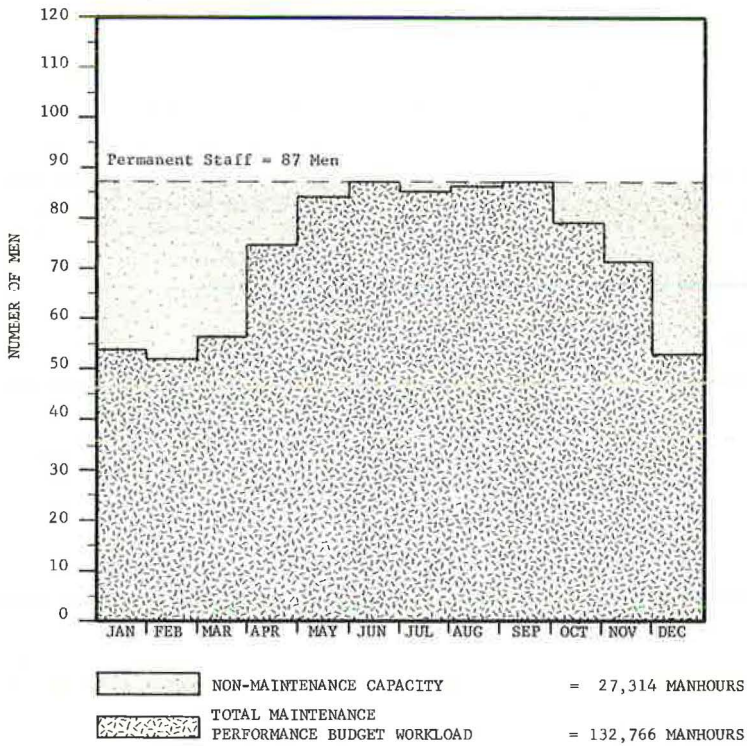


Figure 3. Staffing option I.

TABLE 1
RESOURCE REQUIREMENTS FOR STAFFING OPTION I

Requirement	Amount
Total maintenance performance budget	\$2,433,332
Man-hours available, 87 x 1,840 hr./man/year	160,080
Man-hours required	132,766
Nonmaintenance capacity, man-hours	27,314
Nonmaintenance labor dollar requirement	179,097
Labor cost, 27,314 man-hours x \$3.95	\$107,890
Overhead, 66 percent of labor	71,207
Total budget required at 87-man level	2,612,429
Nonmaintenance dollar requirement to utilize remaining man-hours—labor, 40 percent, and equipment and materials cost, (\$107,890/0.40) - \$107,890	161,835
Total	\$2,774,264

Note: Permanent staff = 87 men.

in Figure 4. There is not only a reduced nonmaintenance capacity over staffing option I, but also a reduction in overhead in the maintenance performance budget due to savings of leave and social benefits not paid to summer hires as given in Table 2. This staffing option results in approximately \$158,000 savings over staffing option I. However, one major disadvantage to the use of summer hires is the limited use and performance that can be realized from these types of unskilled employees.

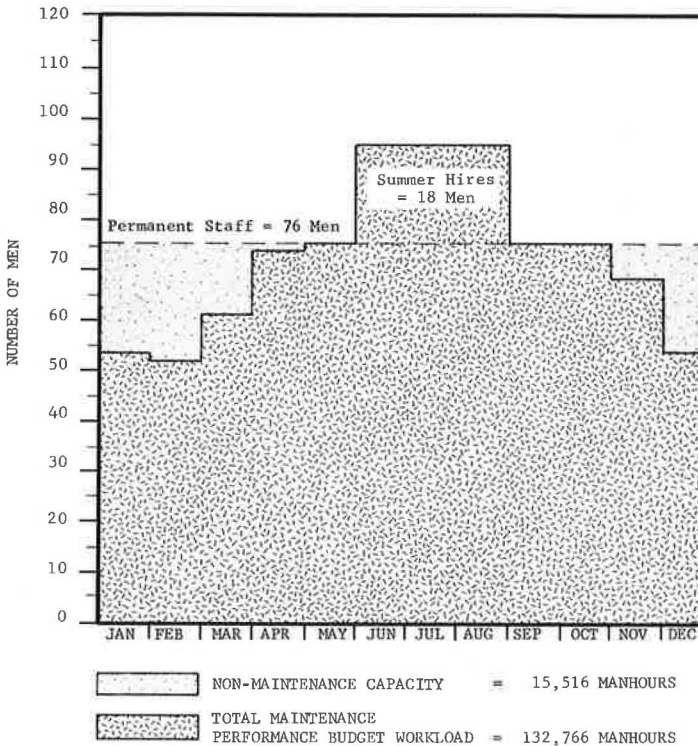


Figure 4. Staffing option II.

TABLE 2
RESOURCE REQUIREMENTS FOR STAFFING OPTION II

Requirement	Amount	
Previous maintenance performance budget	\$2,433,332	
Less overhead for summer hires, 18 x 469 x \$3.95 x 31 percent	<u>(10,337)</u>	
Total performance budget	2,422,995	
Man-hours available, 76 x 1,840 + 18 x 469	148,282	
Man-hours required	<u>132,766</u>	
Nonmaintenance capacity, man-hours	15,516	
Nonmaintenance labor dollar requirement		101,738
Labor cost, 15,516 man-hours x \$3.95	\$ 61,288	
Overhead, 66 percent of labor	40,450	
Total budget required at 76-man level	<u>2,524,733</u>	
Nonmaintenance dollar requirement to utilize remaining man-hours—labor, 40 percent, and equipment and materials cost, (\$61,288/ 0.40) - \$61,288	<u>91,932</u>	
Total	<u>\$2,616,665</u>	

Note: Permanent staff = 76 men; summer hires = 18 men.

Staffing Option III

To eliminate the disadvantage of summer hires cited earlier, the same 76-man permanent staff can be used in staffing option II but by utilizing planned overtime during the summer months in lieu of summer hires (Fig. 5 and Table 3). To generate enough overtime hours to offset 18 summer hires, the 76-man permanent staff would only be required

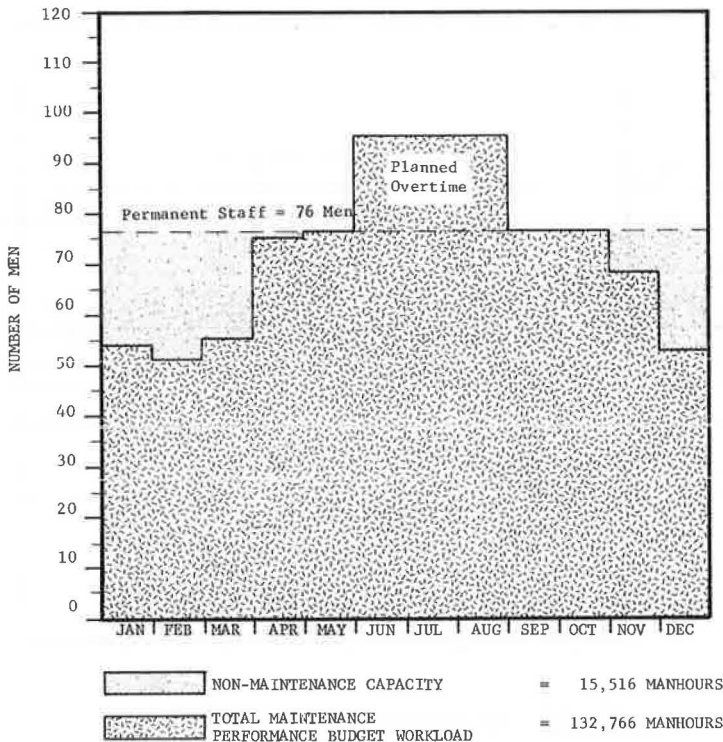


Figure 5. Staffing option III.

TABLE 3
RESOURCE REQUIREMENTS FOR STAFFING OPTION III

Requirement	Amount
Previous maintenance performance budget	\$2,433,332
Plus planned overtime, $18 \times 469 \times \$3.95 \times 0.5$	16,673
Less overhead for overtime, $18 \times 469 \times \$3.95 \times 31$ percent	(10,337)
Total performance budget	2,439,668
Man-hours available, $76 \times 1,840 + 18 \times 469$	148,282
Man-hours required	132,766
Nonmaintenance capacity, man-hours	15,516
Nonmaintenance labor dollar requirement	101,738
Labor cost, 15,516 man-hours \times \$3.95	\$ 61,288
Overhead, 66 percent of labor	40,450
Total budget required at 76-man level	2,541,406
Nonmaintenance dollar requirement to utilize remaining man-hours—labor, 40 percent, and equipment and material cost, $(\$61,288/0.40) - \$61,288$	91,932
Total	\$2,633,338

Note: Permanent staff = 76 men plus planned overtime to equal man-hours of summer hires in staffing option II.

to work five 10-hour days per week instead of the normal five 8-hour days. Since the nonmaintenance capacity is the same as the previous option, the only change in total resource requirements is an additional \$16,673 required for time and one-half for overtime. The additional overtime pay will undoubtedly be offset by the increased performance of the more skilled permanent employee versus the summer hire.

Staffing Option IV

By contracting all mowing and releveling the workload, a permanent staff of 74 men can accomplish the workload as shown in Figure 6. Mowing accounted for approximately 10,000 man-hours in the previous workload distributions and occurred during the peak summer months. The estimated contract cost for the mowing, given in Table 4, is based on existing contract costs in the Michigan county area. Not only is the mowing

TABLE 4
RESOURCE REQUIREMENTS FOR STAFFING OPTION IV

Requirement	Amount
Previous maintenance performance budget	\$2,433,332
Plus estimated contract cost	60,000
Less cost of activity to be contracted	(91,030)
Less overhead of mowing, $10,015$ man-hours \times $\$3.95 \times 31$ percent	(12,263)
Total performance budget	2,390,039
Man-hours available, $74 \times 1,840$	136,160
Man-hours required	122,751
Nonmaintenance capacity, man-hours	13,409
Nonmaintenance labor dollar requirement	87,924
Labor cost, 13,409 man-hours \times \$3.95	\$ 52,966
Overhead, 66 percent of labor	34,958
Total budget required at 74-man level	2,477,963
Nonmaintenance dollar requirement to utilize remaining man-hours—labor, 40 percent, and equipment and materials cost, $(\$52,966/0.40) - \$52,966$	79,449
Total	\$2,557,412

Note: Permanent staff = 74 men; contract all mowing.

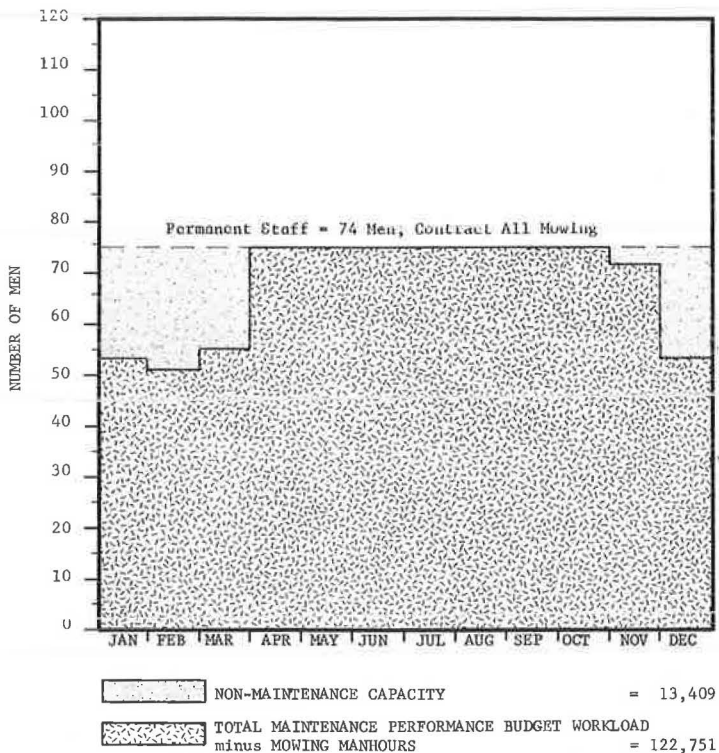


Figure 6. Staffing option IV.

contract cost more than offset by the performance budget cost of the activity, but also the nonmaintenance capacity of this option is the least of any staffing option presented. A total of only approximately \$124,000 would be required in addition to the original maintenance performance budget to utilize the nonmaintenance capacity generated by this staffing option. Table 5 gives a summary of the nonmaintenance capacity and total resource requirements by staffing option.

TABLE 5
SUMMARY OF STAFFING OPTIONS

Staffing Option	Method of Accomplishing Workload	Nonmaintenance Capacity (man-hours)	Total Resource Requirements (\$)
I	Permanent staff of 87 men	27,314	2,774,264
II	Permanent staff of 76 men plus summer hires	15,516	2,616,665
III	Permanent staff of 76 men plus planned overtime to equal man-hours of summer hires in option II	15,516	2,633,338
IV	Permanent staff of 74 men with all mowing contracted	13,409	2,557,412

Note: All options based on a total maintenance performance budget of \$2,433,332 and a workload requirement of 132,766 man-hours.

The staffing options presented above have excluded the analysis of the effect of permanent construction forces on the winter season nonmaintenance capacity since some highway agencies have no permanent construction forces while others have several permanent construction employees. It is readily apparent that, if a highway agency has a large permanent construction force and their construction season is basically limited to the summer period, that agency's winter nonmaintenance capacity will increase drastically.

The number of staffing options are virtually unlimited if we consider the various combinations that can be analyzed, such as contracting certain activities plus planned overtime plus summer hires. A maintenance manager can choose how he wants to staff a planned maintenance workload if he has an effective maintenance management system.