

of axle loads on the pumping which has developed on the north and southbound traffic lanes on three projects. Faulting was twice as pronounced and pumping was practically confined to the points on the northbound lanes where axle loads of over 10,000, 14,000 and 18,000 lb. were respectively seven, nine and

three times greater than for the southbound lanes.

Irrespective of the weight and volume of commercial traffic, pavements placed on natural subgrade soils or on subbases containing more than 50 per cent sand and gravel (material retained on No. 270 sieve) will not pump.

PROGRESS REPORT OF THE COMMITTEE ON MAINTENANCE PERSONNEL

BY REX M. WHITTON, *Chairman*

Maintenance Engineer, Missouri State Highway Commission

SYNOPSIS

A second report of a Maintenance Department Sub-Committee on Maintenance Personnel recommends that attention be given the relative salaries or wages being paid for maintenance jobs in view of the fact that there is such a wide variation in amounts paid the same job in the various State highway departments. The report further recommends that good work by the maintenance employee be rewarded and encouraged by continuity of service, a salary or wage level comparable to that paid by private industry for similar work, a retirement plan, workman's compensation, vacation and sick leave with pay, and other considerations which would provide a better job for the better employee, to the end that better and cheaper maintained highways will result.

This is the second report of the Committee which was appointed for the purpose of making a study of highway maintenance personnel to the end that a report could be prepared containing information and recommendations that would be an aid to securing better and more efficient highway maintenance thru better and more efficient personnel.

The Committee decided to make a study by the questionnaire method of the present personnel policies of the various State highway departments. The Committee's first report was submitted at a meeting of the Maintenance Department of the Highway Research Board at Cincinnati, Ohio, on November 26, 1944, and was subsequently printed in *Highway Research Abstracts*.

In the first report, the Committee reported that only 16 States had a civil service plan; 46 States had workman's compensation (now this has been increased to 47); 18 States had a remunerative retirement plan

(this number has been increased to 21). The first report also noted that vacations and sick leaves with pay were almost universally granted.

The first report carried the facts regarding the working hours per day and per week. The length of the working time for field employees varied from 8 to 10 hr. per day, and from 39 to 60 hr per week.

A detailed tabulation of the foregoing information was attached and made a part of the first report. Since then the tabulation on policies has been checked by each State and a revised tabulation is now attached and made a part of this report.

For the purpose of salary comparison, the first report set up and defined 14 maintenance job titles, and showed for most of the States the range of salaries of these jobs. A listing of these definitions is also attached. A tabulation of the salary or wage for the various

maintenance jobs indicated a wide range in sections as well as over the country as a whole.

To illustrate this wide variation, it was noted that the monthly average wage of common labor varied from \$72.80 to \$167.44, skilled labor from \$104.00 to \$239.12, equipment operator from \$87.50 to \$236.90, mechanic from \$115.00 to \$234.00, sectionman from \$110.00 to \$197.60, gang foreman from \$122.50 to \$286.25, garage foreman from \$132.50 to \$307.50, district maintenance engineer or district foreman from \$169.00 to \$378.33, division maintenance engineer from \$200.00 to \$380.00, state maintenance engineer from \$275.00 to \$833.33.

These wide variations in earnings were due to a small extent to a variation in the number of hours worked, but the greater cause of the variation in earnings was due to the difference in the basic wage or salary rate. For example, the average wage per month for skilled labor varied from \$104.00 in one state to \$239.02 in another state, yet it so happened that each of these states had a 48-hr. week.

In submitting its second report, the Committee felt that tabulation of salaries should be made a part of the report, and this has now been done. In order to avoid any difficulties, the names of the states are not shown on the report, and the usual alphabetical order of listing has been rearranged. The salaries and wages shown are for 1945.

It will also be noted that the salaries of five key jobs, other than maintenance personnel, have been added to the list. Since it is a well known fact that an employee is more interested in his relative salary than his absolute salary, it is thought that a comparison with salaries of other key jobs might be worthwhile.

The salaries shown on the attached tabulation are average monthly salaries and are so shown for ease of comparison. This should not, of course, be taken to mean that actual payment to the employee is made by the month, as such is not the case in a number of states. Again it will be noted that the 1945 tabulation shows a wide variation in salaries paid for the same job. There is no doubt but that some of the wide range is due to a variation in cost of living between different

areas of the country and to hours of employment.

The Committee has reached certain conclusions, which have been arrived at both from the personal experience of its own members and from a study of the personnel policies of the various State highway departments.

The Committee believes that trained personnel and experienced supervisors are the basis of good and efficient highway maintenance. It takes time and costs money to train men. It, then, immediately follows that it is highly desirable to obtain and to keep good men on the job, and consideration should, therefore, be given to ways and means of so doing. If highway departments are to get good men, they must compete with private industry and other agencies.

What is it that attracts a man to a job? There is every reason to believe that the average man on a wage or salary desires economic security more than anything else which comes within the scope of his needs. If, then, the various highway departments provide their employees with a fair chance for economic security, it would seem that good men could be secured and retained.

It, therefore, becomes necessary to define and elaborate on economic security for the wage earner. The first essential of economic security would appear to be adequate assurance of continuity of service. Probably as important as any one factor is the employee's desire for assurance on retaining his job in return for satisfactory service. Sixteen States have assured their employees of continuity of service by the adoption of a civil service system. Other States follow a merit system plan, which is excellent as long as it works. Unfortunately, there are still some States that change maintenance employees with changes in political administration, and this cannot help but result in less efficient highway maintenance at a greater cost to the road user.

Equally important with assurance of continuity of service is the payment of fair wages and salaries. Fair wages and salaries imply, not only that the wage or salary is equal to that paid by other organizations for the same type of work, but also that a fair relationship must exist between the wages or salaries paid to various jobs within the entire highway organization. Determination of relatively

AVERAGE MONTHLY SALARY OF HIGHWAY PERSONNEL

MAINTENANCE PERSONNEL

OTHER KEY PERSONNEL

State Maintenance Engineer	Assistant Maintenance Engineer	Division Maintenance Engineer	Asst Div Maintenance Engineer	District Maintenance Engineer	Garage Foreman	Gang Foreman	Sectionman	Mechanic	Equipment Operator	Mechanic Helper	Clerk or Timekeeper	Skilled Labor	Common Labor	Project Engineer	Chief Of Survey Party	Plans Designer	Bridge Designer	Chief Clerk	Hours Per Week
375.00		300.00			250.00	220.00	185.00	220.00				170.00	130.00	290.00		225.00	300.00		48.0
416.66	320.00	294.38		251.07	187.50	195.55	164.34	184.00	162.00		134.12	170.97	102.15	310.21					48.0
350.00	250.00	300.00	200.00		230.00	160.00	160.00	184.00			140.00		112.50	275.00	250.00	225.00	257.00	200.00	
620.00	412.00	420.00	320.00	330.00	340.00	230.00	240.00	215.00	180.00	165.00	220.00	210.00	155.00	325.00	285.00	230.00	285.00	320.00	40.0
460.00	300.00	297.00		297.00	205.00	195.00	165.00	195.00	233.00	169.00	144.00	169.00	150.00	236.00	178.00	178.00	265.00	288.75	48.0
560.00	422.50	331.66	260.45	233.16	240.00	240.00	185.00	195.52	185.00	185.00	187.00	173.68	158.57	327.00	260.00				50.0
450.00		212.50		175.00	206.67	170.00	170.80	187.50	174.55	156.50	166.67	145.70	123.93		170.00	240.00		170.00	49.5
450.00	325.00	325.00		265.00	168.57	180.00	121.91	144.12	171.25	110.00	166.76	128.26	110.75						55.0
450.00	330.00	265.00			150.00	150.00	120.00	140.00	100.00	90.00	150.00		100.00	200.00	250.00	200.00	300.00	250.00	60.0
475.00	400.00	325.00	280.00	257.00	275.00	220.00	185.00	265.00	197.00	150.00	185.00	230.00	166.40	255.00	230.00	200.00		250.00	48.0
430.00	360.00	285.00		225.00	213.00	155.00	162.00	196.00	141.00	120.00		142.00	122.00	252.00	252.00		252.00		48.0
440.83	297.91	283.33		241.66	165.00	205.00	156.00	146.00	136.00	120.00	150.00		127.00	250.00					45.0
423.75	361.25	303.75	260.45	234.00	234.00	186.91	151.92	171.95	160.00	124.72	153.14	145.49	130.00	239.24	209.57	230.00	245.93	235.00	54.0
375.00	340.00	292.00		200.00	247.00	146.00	20.00	184.30	52.64	117.80	132.60		18.46	233.49	257.80	256.54	269.38	215.83	48.0
575.00	425.00	325.00		164.00	214.00	166.00	130.00	160.00	121.00	114.00	114.00	115.00	95.00	238.00	238.00	285.00	285.00	225.00	50.0
403.00	275.00			173.00	214.00	169.00	127.96	146.40	208.00	135.20			127.96	254.52	254.52	254.52	254.52		
416.67		300.00		234.00	182.00	163.00	163.00	163.00	162.00		150.00	157.00	104.00	221.00	234.00	260.00	277.00		48.0
530.00	380.00	380.00	320.00	250.00	190.00	179.40	157.02	166.00	215.28		161.00	157.02	150.00						45.0
575.00	450.00			250.00	200.00	200.00	195.00	170.62	170.62	170.62	160.00	156.00	36.50						40.0
465.00	390.00	337.50		215.00	215.00	162.10	144.00	181.25	154.50	145.80	145.05	128.25	112.50	273.00	220.00				48.0
400.00	295.00	303.00		221.36	195.00	143.57	111.29	147.08	116.97	105.00	158.62	96.89	72.98						48.0
465.00	326.67	304.50	260.45	214.50	220.55	166.66	138.44	159.17	116.40	37.70	187.50	127.40	106.16	246.94	225.00	219.59	247.14	209.44	50.0
375.00	350.00			275.00	240.00	225.00	200.00	218.40	180.00	179.92	185.00	190.00	171.80	228.33	240.00	248.33	263.33	235.00	48.0
365.00				260.00	191.00	161.50	140.00	155.00	160.00	151.00	127.50	170.00	37.00	262.00	260.00	260.00	253.00	177.50	54.0
378.00		315.00	260.00	240.00	270.00	220.00	190.00	225.00	220.00	200.00		220.00	190.00	208.62	191.69	245.00	265.00	210.00	48.0
362.50		253.75		193.25	194.00	217.00	191.00	173.00	171.60	146.25	135.00	152.53	133.47						48.0
450.00	275.00	275.00		235.00	225.00	143.00	106.00	167.00	137.00	114.16	137.50	184.80	107.59	210.00	235.00	235.00	247.39	314.16	44.0
875.00	875.00	537.50		416.66	225.00	225.00	160.47	70.83	151.83	114.16	312.00	220.00	135.00	271.87	250.00	250.00	267.50	250.00	56.0
425.00		340.00		240.00	190.00	170.00	207.35	136.40	160.00	115.00	150.00	135.00	90.00	322.50	322.50	322.50	322.50	250.00	44.0
350.00	275.00	260.00		240.00	190.00	183.00	165.00	180.00	140.00	115.00	150.00	135.00	90.00	260.00	245.00	280.00	290.00	250.00	55.0
450.00	425.00	348.48	287.40	226.60	250.00	224.70	190.00	185.00	150.00	150.00	150.00	208.20	125.00	235.00	235.00	230.00		185.00	48.0
400.00	310.00	290.00		215.00	275.00	180.00	180.00	225.50	204.46	197.23	184.37	179.49	179.49	315.60	310.70	375.40	360.70	233.16	48.0
450.00	345.00			310.00	250.00	223.00	195.00	213.00	186.00	183.00	190.00	172.00	152.00	277.50	277.50	310.00	275.00	250.00	48.0
550.00	375.00	337.50	297.00	312.50	194.00	162.50	150.00	162.00	155.00	150.00	135.00	150.00	117.00	208.00	187.00	225.00	287.00	320.00	44.0
347.50	230.00	250.00		200.00	200.00	173.33		195.35	151.67	156.00	165.00	156.00	147.33						40.0
320.00	200.00	205.00		270.00	170.00	150.00		195.35			127.50	134.32	85.00	265.00	252.50	247.50	232.50	190.00	50.0
391.00		305.00	255.00	231.00	201.50	208.00	175.50	188.50	182.00	162.50	150.00	162.50	136.50	239.00	239.00	233.00	249.00	165.00	60.0
687.50	423.50	348.50		180.00	236.00	179.08	160.47	196.00	107.00	119.00		107.00	90.00						55.0
320.00		210.00	227.50	180.00	220.00	192.00	180.00	184.00	160.00	150.00	160.00	174.00	136.84	230.00	230.00	200.00	250.00	195.00	44.0
500.00	375.00	290.00		135.00	160.00	105.00	150.00	203.75	176.70	153.50	145.59	145.59	124.79	224.38	180.00	180.00	220.00	320.00	48.0
500.00	395.00	392.50	325.00	309.50	305.00	250.10	105.00	135.00	85.00	105.00	105.00	83.20	72.20	160.00	215.00	160.00	215.00	160.00	48.0
375.00	325.00	250.00		225.00	186.33	154.67	135.67	164.67	164.67	122.67	125.67	164.67	100.53	308.75	242.80	241.80	310.00	225.00	44.0
														256.05	241.07	242.98	266.61	232.53	
446.42	355.54	307.01	272.73	240.92	218.23	184.03	162.49	183.60	165.14	145.40	158.04	161.52	126.38						

Each Horizontal Line Represents The Salaries Of A Single State
 States Are Not Listed Alphabetically
 Names Of States Not Shown For Obvious Reasons

Averages

fair wages and salaries can be accomplished by a job evaluation plan.

Job evaluation consists mainly of an analysis and pricing of jobs, or as one author defines it "a measurement of the qualities and abilities necessary to carry the load under the assigned conditions of work"

There are four basic systems of job evaluation, which are generally known as the Ranking System, the Classification System, the Point System, and the Factor Comparison System¹

The Ranking System and the Classification system use non-quantitative methods of placing jobs in order of difficulty or importance, and either of these methods are apt to perpetuate inequalities of salary which now exist. The Ranking System consists of arranging positions in the order of their importance, grouping the list into various classes, and then establishing salary ranges for each class. The Classification System consists of establishing a series of classifications with a salary range for each and, then, arbitrarily placing the jobs in the predetermined classifications. Both systems involve the passing of a blanket judgment on a job as a whole.

The Point System and the Factor Comparison System are similar, in that they break the job down by analysis into basic factors and measure these factors both qualitatively and quantitatively. The Point and Factor Comparison Systems provide for the use of specific units of measurement, the total of which definitely establishes the relative value of each job.

A study of many job evaluation systems in use today indicates that the four major factors generally used are—skill, effort, responsibility, and job conditions.

"Skill" is defined as the minimum amount of education and/or experience required to do the job. "Effort" or "Demand" is the minimum amount of mental and/or physical effort required to do the job. "Responsibility" is gauged according to the probable loss that might result from an error in handling equipment or materials, to the number of persons supervised, and to the amount of personal contact required by the job. "Job Conditions" is gauged according to the hazards involved, whether the work is indoors or out-

doors, whether job must be performed under all weather conditions, etc. By ascribing varying point values to these factors, by determining the point value of each factor in each job, and by totaling the point value of all the factors, it is possible to obtain an accurate relative point value for each job.

The use of any one of these four systems of job evaluation is better than using no system, but, in view of the different lines of work and authority in most highway departments, it is believed that the Point System or the Factor Comparison System will be found most satisfactory in evaluating the jobs in a state highway department.

Along with job evaluation, a personnel merit rating system should be established and used. Obviously there are differences between individuals in the performance of the same job, based on differences in skill, experience, willingness, and other factors. Personnel merit rating is a technique for measuring manpower performance. There must be personnel merit rating for the purpose of recognizing these differences.

A job evaluation and personnel rating plan will provide a systematic wage and salary administration, to the end that a fair day's wage will be paid for a fair day's work.

A retirement plan is another item that is very desirable to the wage and salary earner and fits into his idea of economic security. The Committee's study reveals that the employees of 21 States now have the advantage of a retirement plan. All of the States now having a plan indicated that it is desirable.

Another factor in economic security for the employees is workman's compensation, which provides for the employee injured in line of duty. It is fortunate that 47 of the 48 States now provide workman's compensation.

Many private corporations and companies are now providing health insurance for employees. It does seem that public organizations, such as highway departments, could go as far as the formation of group insurance associations and encourage the employee to join in order to obtain the benefits at a cheaper rate.

Although the policy of granting vacations and sick leaves of definite length on full pay each year does not add to the economic security

of the employee, it is highly valued by the employee and adds definitely to his morale. Practically all States now follow this policy with considerable variation in the length of time granted each year for both the vacation and sick leave. One variation of the sick leave policy followed by some of the States seems particularly desirable, and that is the policy of allowing sick leave to accumulate up to a certain length of time when not used each year.

There, also, is the item of expenses when the employee's work takes him away from his home. This is a matter that should be recognized; most States pay field expenses when away from home by allowing actual expenses or a per diem allowance.

The length of the working day and week should receive serious consideration. The time worked per day now varies among the States from 8 to 10 hours. At this time it does not seem logical that the length of the working day for a maintenance field worker should be reduced below 8 hours.

It is believed that thought should be given to some type of recognition for employees who have worked a long period for the State. Recognition of long and faithful service will tend to build up the morale of the organization.

Much attention has been given by private industry to employee relations for the purpose of improving morale. Highway department officials could well afford to take advantage of some of the personnel policies that have been proven sound in private industry.

The war years, with their scarcity of manpower, have definitely proved the high value of trained personnel in highway maintenance work or any other work. It is the opinion of this Committee that trained workmen will continue to pay high dividends in efficiency and quality of workmanship in the peacetime maintenance of highways regardless of how plentiful workers may become.

Much time and money have been spent in research to improve material and machinery. It is high time that research work be done with men. The results will be amazingly profitable to the employer and employee.

Definitions of Maintenance Personnel Titles

State Maintenance Engineer

One in an executive capacity who supervises

the activities of the maintenance bureau of the State highway department.

Assistant Maintenance Engineer

One who assists the State Maintenance Engineer in the work of supervising the activities of the maintenance bureau.

Division Engineer

One in an executive capacity who supervises all highway activities within a division including maintenance.

Division Maintenance Engineer

One who supervises the maintenance of highways within a division, which usually comprises from 1000 to 2000 miles of highway.

Assistant Division Maintenance Engineer

One who assists the Division Maintenance Engineer in supervising maintenance operations in the division.

District Maintenance Engineer, or District Foreman

One who directs the activities of all maintenance employees and oversees the maintenance of highways within a district usually comprising a highway mileage of from 200 to 800 miles

Garage or Shop Foreman

One who is responsible for the operation of a garage and the supervision of the maintenance and repair of equipment.

Gang Foreman

One who directs the activity of a group of men engaged in special maintenance and betterment work, such as a grading crew, bituminous repair crew, concrete pavement patching crew, bridge repair crew, center-line marking crew, roadside maintenance crew, etc.

Sectionman

One who in reality is a working foreman, who can and does do any of the work necessary to properly maintain the highways within a specified territory, usually comprising a mileage of from 25 to 75 miles, and in addition supervises the work of operators and laborers when necessary. A highly skilled and trained man.

Mechanic

One who repairs and supervises helpers in the repair of all types of equipment.

Equipment Operator

One who operates motorized equipment (excepting trucks) used in maintenance and betterment work.

Mechanic Helper

One who assists the mechanic in the repair of all types of equipment and does certain mechanical work under direct supervision.

Clerk or Timekeeper

One who keeps the time records of employees,

hours of equipment usage, quantities of materials received, used and on hand, maintenance cost records, etc.

Skilled Laborer

One who through special training or experience has become proficient in such a trade as carpenter, painter, mason, plumber, or such work as patrolman helper, bridge repair man, truck driver, etc

Common Laborer

One who performs manual labor

Note In the foregoing definitions of titles of maintenance personnel, the first subdivision in the State for supervision purposes is called a division, the second subdivision is called a district

Additional Definitions of Titles of Key Personnel Other Than Maintenance

Project Engineer

One who has charge in the field of one or more highway construction projects under the general supervision of a Division Construction Engineer and/or a Division Engineer.

Chief of Survey Party

One who has charge in the field of a highway survey party with some latitude for exercising individual judgment but under the general supervision of an Assistant Division Engineer and/or a Division Engineer.

Plans Designer

One who designs highway construction plans, such as laying grade line, preparing intersection layouts, determining sizes and lengths of drainage structures except bridges, preparing construction estimates, etc—all under the direct supervision of a Chief Designer

Bridge Designer

One who designs highway bridges under the direct supervision of a Chief Bridge Designer

Chief Clerk

One who has a knowledge of modern office methods, procedures and equipment, business arithmetic and business english, and supervises a large group of clerical employees, engaged in performing important clerical work.

PROGRESS REPORT OF COMMITTEE ON HIGHWAY MAINTENANCE COSTS AND OPERATING METHODS

By J. S. BRIGHT, *Chairman, Deputy Commissioner,*
Public Roads Administration

SYNOPSIS

In an effort to arrive at comparative costs, field maintenance engineers of the Public Roads Administration were asked to secure from State highway departments such data for individual maintenance operations on portland cement concrete pavements as were readily available. A description was also requested of the materials and practices on the operations studied. This progress report furnishes the results of the survey and also an analysis of costs on: (1) filling joints and cracks, (2) patching concrete pavements with bituminous materials, (3) patching concrete pavements with concrete, (4) drilling holes and materials for mud-jacking operations, (5) shoulder maintenance, (6) clearing and shaping of drainage ditches, and (7) painting of center-line traffic stripes.

The performance of road maintenance to preserve the nation's streets and highways cost \$659,000,000 in 1941, the last year of normal operations before the war. This sum represented the annual cost of all road maintenance operations throughout the United

States. Analysis of maintenance performance over a period of years on representative road sections discloses that on the average 45 per cent of the expenditures is made for direct labor, 21 per cent for materials, 25 per cent for equipment and 9 per cent for overhead.