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An Inquiry Into the Buildings and Grounds Department of the University of New Mexico

Raymond P. Lutz

THE BUILDINGS AND GROUNDS DEPARTMENT OF THE UNIVERSITY OF NEW MEXICO - LUTZ

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AN INQUIRY INTO THE BUILDINGS AND GROUNDS DEPARTMENT OF THE UNIVERSITY OF NEW MEXICO

By

Raymond P. Lutz

A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Business Administration

The University of New Mexico

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This thesis, directed and approved by the candidate's committee, has been accepted by the Graduate Committee of the University of New Mexico in partial fulfillment of the requirements for the degree of

MASTER
OF BUSINESS ADMINISTRATION

Stuart E. Northrop
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Date June 8, 1962

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INTRODUCTION

The purpose of this thesis is to examine the Buildings and Grounds Department of the University of New Mexico. This examination will consist of two major facets. The first will be a broad evaluation of the maintenance program as it presently exists and a comparison of this program with those of other universities around the country. The second major section will be an investigation of the feasibility of subcontracting some of the maintenance functions now performed by the Buildings and Grounds Department to see whether this would be advantageous to the University.

At this stage the question usually arises: What is the scope of the University's maintenance program? After all, the Department of Buildings and Grounds is thought of as that group which, with varying degrees of proficiency and dependability, services and protects the various University establishments and activities. A complex maintenance problem arises from the department's efforts to carry out these services. Whereas at one time maintenance work may have been a job for the person with a strong back and a weak mind, today it is a job for specialists skilled in their respective trades.

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While it is generally known by all that a Department of Buildings and Grounds exists, its role in the over-all

University complex is still unanswered. Table 1, page 3, shows that fifteen to sixteen percent of the total University budget is expended on the operation and maintenance of the physical plant, or about one quarter of the amount devoted to instructional expenses, the main purpose for the school's existence. This budget outlay for the Buildings and Grounds Department has remained a fairly constant percentage as the University's total budget has risen in the last decade. This expenditure, as shown in Table 3, page 5, is 10.1% of the total budget during the years 1958 through 1960.[1]

The real magnitude of this expenditure can be noted in Table 2, page 4. The operation of the physical plant at the University of New Mexico is a million dollar business annually. Since the department charges certain expenses to other departments, and the operation of the heating plant is carried on the books as a separate item, the actual expenditure is shown in Table 3, page 5, as \$811,593.50. The large amount of money involved in maintenance budges is the reason small schools are becoming big business and large schools are surpassing this.

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TABLE 1

DISPOSITION OF THE UNIVERSITY OF NEW MEXICO'S EDUCATIONAL OPERATING DOLLAR

(Figures in Dollars)

Expenditure	1960[a]	1959[b]	1958[b]
Administration and General	0.14	0.13	0.13
Instruction	0.63	0.61	0.61
Extension Division	0.02	0.02	0.02
Library	0.05	0.05	0.05
Operation and Maintenance of Plant	0.16	0.15	0.15
Used for Other Activities	----	0.04	0.04
Total	1.00	1.00	1.00

[a]University of New Mexico, Financial Report, For the year ended 30 June 1960, Albuquerque, New Mexico.

[b]University of New Mexico, Financial Report, For the year ended 30 June 1959.

TABLE 2

STATEMENT OF SELECTED REVENUES AND EXPENDITURES WITH BUDGET COMPARISONS AS THEY APPLY TO THE BUILDINGS AND GROUNDS DEPARTMENT OF THE UNIVERSITY OF NEW MEXICO[a]

(Figures in Dollars)

Expenditure	Budget Estimate	Actual Expenditure	Actual (Over) Under
Total Educational and General	5,240,000.00	5,155,681.02	84,318.98
Operation and Maintenance of Physical Plant	910,000.00	973,710.71	(63,710.71)
Less Charges Applied to Other Departments	90,000.00	162,117.21	(72,117.21)
Total Operation and Maintenance	820,000.00	811,593.50	8,406.50

[a]University of New Mexico, _Financial Report_, For the year ended 30 June 1960, Albuquerque, New Mexico.

TABLE 3

COMPARISON OF TOTAL YEARLY EXPENDITURES OF THE UNIVERSITY OF NEW MEXICO WITH PHYSICAL PLANT EXPENDITURES

(Figures in Dollars)

Expenditure	1960[a]	1959[b]	1958[b]
University Total	8,018,379.39	6,770,026.19	6,405,772.27
Total Educational and General	5,155,681.02	4,486,738.84	4,134,969.50
Total Operation and Maintenance of Plant	811,593.50	685,487.00	648,434.18

[a]University of New Mexico, Financial Report, For the year ended 30 June 1960, Albuquerque, New Mexico.

[b]University of New Mexico, Financial Report, For the year ended 30 June 1959.

universities today is the coming of age of the population explosion. From the depression of the 1930's and the holocaust of World War II, the sagging birth rate has changed its course upward, boosting birth records to new heights each succeeding year. Couple this with two decades of prosperity, and the universities will face increased enrollments far sooner than increased tax revenues will come to their rescue. The University of New Mexico will be no exception to this forecast. In 1959 the enrollment of the University was 7,284 students with sixty-nine academic and service buildings containing 1,425,000 gross square feet of floor area.[2] In 1970 the expected enrollment will reach 18,000 students with 1,200,000 gross square feet in additional buildings necessary.[3] This rapid rise coupled with a state constitution that prohibits deficit financing indicates an enrollment revenue squeeze could take place. President Popejoy recognized this when he stated:

> Budgets will tighten. The college-age population and the percentage enrolling are increasing more rapidly than the tax income of the state. . . . An increase from 18,000 to 25,000 [students] would require an additional 1,000,000 gross square feet [of building space].[4]

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[2]John Carl Warnecke and Associates, General Development Plan for the Campus of the University of New Mexico (San Francisco, California, 1960), p. 10.

[3]Ibid., p. 11 [4]Ibid., p. 12

universities today is the coming of age of the population explosion. From the depression of the 1930's and the holocaust of World War II, the birthrate in this country has changed its course upward, mounting with seeming vigor to new heights each succeeding year. Along with this has been a period of prosperity, and the universities must face increased enrollments far sooner than increased tax revenues will come to their rescue. The University of New Mexico will be no exception to this forecast. In 1960 the enrollment of the University was 7,284 students with eighty-nine academic and service buildings totaling 1,445,000 gross square feet of floor area.[2] In 1975 the expected enrollment will reach 18,000 students with 1,200,000 gross square feet in additional buildings necessary.[3] This rapid rise coupled with a state constitution that prohibits deficit financing indicates an enrollment revenue squeeze could take place. President Popejoy recognized this when he stated:

> Budgets will tighten. The college-age population and the percentage enrolling are increasing more rapidly than the tax income of the state. . . . An increase from 12,000 to 18,000 [students] would require an additional 1,000,000 gross square feet [of building space].[4]

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[3] Ibid., p. 11. [4] Ibid., p. 31.

One would logically reason that as the total enrollment and gross area of campus buildings increased, the amount of money spent on maintenance and operation of the physical plant would have to increase also. The University should take a critical look at the sixteen cents out of every dollar spent that goes into their maintenance and operation. Reducing maintenance costs would be the same as finding a new source of revenue. A prominent industrial consultant who has studied maintenance systems throughout the country feels that a twenty-five percent reduction in maintenance costs would come quickly in most operations through good maintenance control.[5]

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[5]Techniques of Plant Maintenance and Engineering, Vol. XI, Proceedings of the Technical Sessions held concurrently with the 1960 Plant Maintenance and Engineering Show, Philadelphia (New York: Clapp and Poliak, Inc., January, 1960), p. 71.

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AN INQUIRY INTO THE BUILDINGS AND GROUNDS
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CHAPTER I

PRESENT MAINTENANCE FUNCTIONS

The primary purpose of any maintenance activity is to minimize the maintenance cost without sacrificing quality or human safety. It is on this premise that the Buildings and Grounds Department was established. At the present time it encompasses all activities connected with the operations and maintenance of the University's physical plant. Therefore, before it can be properly evaluated or examined, it is necessary to know what divisions go into the over-all department and what the duties of each division are. As in geometry where the whole is equal to the sum of its parts, one cannot properly examine any organization without first defining its several duties and responsibilities.

The work to be covered under any of the defined maintenance functions consists of furnishing all labor, plant, equipment, appliances, transportation, supervision, and materials. All areas and listings of facilities in this paper have been computed from drawings of the buildings and general layout plan of the campus or were found in official University publications.

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All computations concerning methods and expenses of the present Buildings and Grounds Department are also found in these figures.

At present, as shown in Table 6, page 65, there are one hundred and forty Buildings and Grounds employees maintaining sixty-nine academic and service buildings with 1,425,000 gross square feet of floor area of which 986,700 square feet are occupied by academic and supporting services, 335,350 square feet by residential area and 102,950 square feet by non-university activities.[6] Each of the present maintenance functions should be examined in its respective order.

Sanitation Maintenance

Sanitation maintenance includes both janitorial services and garbage and trash collection. Janitorial services include cleaning of all class rooms, laboratories, machinery spaces, student service and recreation areas, athletic areas, storage areas, office space, residential areas, toilet rooms and anterooms, locker rooms, corridors, vestibules, stairs, entrances and walks, exterior steps, platforms. This cleaning includes walls, ceilings, floors, doors, glass, plumbing fixtures, electrical light fixtures, hardware, furniture, blinds. Waste containers and ash receptacles are emptied;

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[b]Warnecke, p. 10.

all chalkboards are cleaned unless otherwise specifically noted; and all supplies such as paper towels; toilet tissue, soap, chalk, must be replenished.

Garbage and trash collections are made on the prescribed route from containers in the designated pick-up areas a minimum of three times a week. All containers and pick-up areas are left in a clean and tidy condition after each collection, and collection methods are such that the container will not suffer excessive damage. At this time some definitions may be necessary to avoid confusion to a potential or existing custodian on a trash collection route. These definitions also apply to the minimum performance specifications in Appendix I, page 155.

Container - A container is any type of can, with or without a lid, or box used to retain garbage or trash.

Garbage - Garbage consists of animal or vegetable waste resulting from handling, preparation, cooking and consumption of food.

Trash - Trash consists of paper, boxes, glass, tin cans, waste materials from construction, waste products from laboratories, broken concrete, tree and shrubbery limbs.

Landscaping and Grounds Maintenance

The areas around both new and existing buildings, malls, athletic fields, parking lots, and so forth are or shall be landscaped according to the design submitted by the Campus Planning Co-ordinator or the Campus Landscape Architect. Since the Campus Master Plan calls for land coverage by buildings to be an average of twenty percent of the gross land area, proper landscaping and grounds maintenance are of utmost importance. A green park-like area is already a part of the campus and requires constant maintenance in this arid climate. This green area will contrast with the desert plantings and rock and dirt areas which are to surround the major portions of the campus building groups.[7]

Maintenance of the grounds includes the care of lawns, shrubbery and flowers, unplanted areas, walks, streets, parking lots, and so on. Lawn care includes mowing, edging, irrigation, fertilizing, undesirable growth control, and insect control. Care and maintenance of shrubbery and flowers includes undesirable growth control, irrigation, fertilizing, pruning and spraying. All grounds areas are kept in a clean and tidy condition.

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[7] For details of the proposed landscape architecture plan, see John Carl Warnecke and Associates, <u>General Plan for the Campus of the University of New Mexico</u>.

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Vehicle Maintenance

The University operates and maintains not only a motor pool of automobile vehicles, but also a collection of special purpose, limited use vehicles. As shown in Table 6, page 65, there are fifty pieces of automotive equipment and twelve pieces of heavy equipment. The automotive equipment varies from eight recent model automobiles and station wagons to vintage veterans of World War II used as maintenance vehicles.[8] A complete maintenance program is carried out on these vehicles, including preventive maintenance, emergency maintenance to correct malfunctions or breakdowns and complete renovation programs.

Typical services performed include painting and body work, lubrication, engine tune-ups, overhauls and replacements, transmission and gear train work, steering linkage and brake maintenance, and so forth. The Department also operates its own service station facilities for dispensing gas, oil, and water as necessary.

Mechanical and Electrical Maintenance

A wide range of skills is involved in the mechanical and electrical maintenance work done by the Buildings and

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[8] Interview with John A. Jacobson, Superintendent of the Physical Plant, University of New Mexico, June, 1961.

Vehicle Maintenance

The University operates and maintains not only a motor pool of passenger vehicles, but also a collection of special purpose, limited use vehicles. As shown in Table 6, page 33, there are fifty pieces of automotive equipment and twelve pieces of heavy equipment. The automotive equipment varies from eight recent model automobiles and station wagons to vintage vehicles of World War II used as maintenance vehicles.[6] A complete maintenance program is carried out on these vehicles, including preventive maintenance, emergency maintenance to correct malfunctions or breakdowns and complete renovation programs.

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Mechanical and Electrical Maintenance

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[6] Information taken from [illegible] reports of the Physical Plant, University of New Mexico, June, 1961.

Grounds Department. As in the automotive shops, the mechanical and electrical group is responsible for preventive maintenance, emergency maintenance, renovation and remodeling of existing equipment and buildings. The assigned tasks of the mechanical and electrical divisions range from the replacing of a faulty faucet washer or oiling a motor to installing the lighting system in the new football stadium. When one thinks about the bewildering variety of mechanical and electrical devices about the campus, not to mention the plumbing and lighting system, it is amazing that slightly less than twenty percent of the total work force of the Department is devoted to this work.[9]

Since the skills involved in mechanical and electrical maintenance are quite diverse, the following list will tend to provide an idea of the coverage. This group of trade skills includes mechanics, welders, sheet metal workers,

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[9]Adapted from answers given by the University of New Mexico on the Questionnaire. The Questionnaire was mailed to 109 universities and colleges of various enrollments in North America. The purpose of this questionnaire was to provide comparative information on the operation of Departments of Buildings and Grounds. The data obtained were to aid in a comparison of the Buildings and Grounds Department at the University of New Mexico with other institutions of higher learning. A summary and explanation of the data obtained from the Questionnaire can be found in Chapter II. A copy of the Questionnaire is included in Appendix II, page 165.

[illegible]

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[illegible]

steam fitters, plumbers, heating and water distribution personnel, air conditioning and ventilation personnel, refrigeration personnel, electricians, and safety inspectors. Maintenance work on the air conditioning controls, elevators, campus phone system, and office machines is let out on maintenance contracts and therefore is not included in this group.

Building Trades

Again, as in the case of the mechanical and electrical maintenance, the utilization of the building trades skills by the Buildings and Grounds Department is quite diverse. The assigned tasks will vary from replacing a broken window pane to an average maximum of $50,000 allotted on major renovation or remodeling jobs or on new construction. The conversion of the old Student Union Building into an Anthropology Building and Museum is a typical example. These trades also do preventive maintenance and emergency maintenance, for example, painting metal sash windows to prevent rusting or repairing a faulty roof following an infrequent rain storm.

Slightly over twenty percent of the total personnel of the Buildings and Grounds Department is devoted to the

building skills.[10] Some of the trades represented are painters, masons, millwrights, roofers, plasterers, and carpenters. None of the members of the building trades or of the Buildings and Grounds Department for that matter are represented by a union; so it is possible for the workers to cross craft lines without jurisdictional disputes arising.

Miscellaneous Service Needs

The final group of personnel in the Buildings and Grounds Department does not fall into any one of the principal maintenance groups and, for this reason, is simply lumped together in this potpourri. The administration is handled by the Director of the Physical Plant and his assistant, the Superintendent of the Physical Plant. There are also foremen, clerks, and various committees to aid in the administrative task. The actual organizational structure will be discussed later in this paper.

One locksmith maintains the locksets, door closers, and other related hardware. Unfortunately the University does not have a master key system for the whole campus, so the locksmith is kept active enough to require a helper at

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[10] Adapted from answers given by the University of New Mexico on the Questionnaire. See Appendix II, page 165.

frequent intervals. The standardization of locks is being completed, however, and will be of considerable benefit to those working about the campus.

Another problem of the Buildings and Grounds Department is that of security. Eight Campus Police and night watchmen not only handle campus security and criminal investigations but also the daily traffic and parking control nightmare.[11] Since the University is on state land and not a part of the city, a jurisdictional dispute arises with the city police, thus making a separate security force mandatory. With student exuberance what it is, this group of employees has to maintain probably the greatest level of understanding in the Buildings and Grounds Department.

The final responsibility of the Buildings and Grounds Department is the operation and maintenance of the heating plant. This facility supplies the campus with steam for heating, chilled water for air conditioning, and also its water.[12] Since this division is carried as a separate entity on the University's books, it will be eliminated from further consideration, except to say that such a centralized utility function is far more efficient than buying the necessary

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[11] Data from answers given by the University of New Mexico on Questionnaire, Appendix II, page 165.

[12] Note: Outlying buildings such as the Research Center are an exception to this.

[illegible] [illegible]. The [illegible] of [illegible] to be [illegible] completed [illegible] [illegible] [illegible] the [illegible] those working [illegible] in [illegible].

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The final [illegible] of [illegible] the [illegible] department is [illegible] point. This [illegible] [illegible] [illegible].[11] [illegible] [illegible] [illegible] [illegible] [illegible]

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services at individual locations and should be utilized whenever possible.[13]

From the preceding discussion it is evident that the Buildings and Grounds Department is a large and complex organization encompassing many phases of University operation. While "bigness" is not necessarily good or bad, large organizations are usually ripe for comparative investigations with an eye on more efficient operation. After all, a ten percent reduction in operational costs would free almost $100,000 for other University uses.

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[13] For justification of this statement, see explanation and calculations in Appendix III, page 173.

CHAPTER II

COMPARATIVE ANALYSIS OF THE EXISTING MAINTENANCE PROGRAM

As pointed out in the introduction, one of the major purposes of this paper will be to examine the present Buildings and Grounds Department to see how well it adheres to "ideal concepts," within practical limits, and how the maintenance operation at the University of New Mexico compares with similar operations in other universities.

Need for Evaluation

A fairly common childhood experience involved the narrow-mouthed cookie jar. When one reached one's hand in and picked up a handful of cookies, one was usually forced to drop some to enable one to get one's hand out of the jar. Maintenance economics are somewhat like this. It is not always possible to achieve every possible saving in practice, for the University is established to serve the students first, and the faculty second, with the Buildings and Grounds Department far down the list.

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[illegible]

As pointed out in the [illegible] one of the major purposes of this paper [illegible] and [illegible] concepts, [illegible] classification, and [illegible] operation at the University [illegible] similar operations in other universities.

Need for evaluation

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The maintenance problem might be said to be analagous to that of woodslore survival. With effort an average observant and competent person can "live off the land;" however, a properly trained person using the best techniques has a chance to really "live" for a period of time, rather than simply exist. Unfortunately, most maintenance departments, in both industry and universities, simply exist rather than take the opportunity for dynamic leadership to find new and more efficient methods to accomplish age-old tasks.

Possibly one reason for this "hand-to-mouth" existence is that colleges have lived in a state of emergency for the past fifteen years. First it was building temporary structures to handle the flood of returning veterans; then it was expanding facilities such as roads and utilities to keep up with the temporary expansion; and finally it was planning permanent buildings to replace temporary or obsolescent ones. Now the problems of married students and limited parking facilities appear before the school has a chance to catch its second wind. Given these distractions, one can see why a great deal of time has not been devoted to thinking of new solutions to old problems.

The usual comment at this stage is that one cannot evaluate an activity like maintenance with any degree of

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The usual comment at this stage is that one cannot evaluate an activity like maintenance with any degree of

accuracy; yet people evaluate the maintenance program every time they drive by the campus or enter a building. In spite of the fact that maintenance performance is difficult or next to impossible to evaluate, management must evaluate it to get an over-all picture of the proficiency of the organizations. Since maintenance is going to always be evaluated, the question is how: subjectively or objectively? Will it be a matter of opinion or will it be based on facts?

Any comparison or evaluation must have a standard of comparison; therefore, some standard of maintenance must be developed. One method is plotting the percentage of planned work versus time, as in Figure 1.[14] Plotting charts such as the load chart in Figure 1 cost money, but it is necessary to evaluate maintenance programs fully. It will be money well spent with a profitable return. Objective measurement is normally superior to subjective measurement. Since any measurements made will be rough, one must look at the over-all picture.

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[14] The load chart in Figure 1 is a graphical indication of the time scheduled for various maintenance functions by the separate maintenance divisions. After an allotment for emergency work, other maintenance requirements, such as preventive maintenance, are scheduled. The chart then gives an immediate picture of how well each division is utilized and also how much time is spent by each division on a particular job classification. This chart is idealized to the extent that each division is allotted the same number of man hours per month.

accuracy, yet people evaluate the maintenance efforts every time they drive by the campus or enter a building. In spite of the fact that maintenance performance is difficult or next to impossible to evaluate, management must evaluate it to get an over-all picture of the productivity of the organization. Since maintenance is going to always be evaluated, the question is how: subjectively or objectively. Will it be a matter of opinion or will it be based on facts?

Any comparison or evaluation must have a standard of comparison; therefore, some standard of maintenance must be developed. One method is plotting the percentage of planned work versus time, as in Figure 1.[14] Plotting charts such as the load chart in Figure 1 cost money, but it is necessary to evaluate maintenance programs fully. It will be money well spent with a profitable return. Objective measurement is normally superior to subjective measurement. Since any measurement made will be rough, one must look at the over-all picture.

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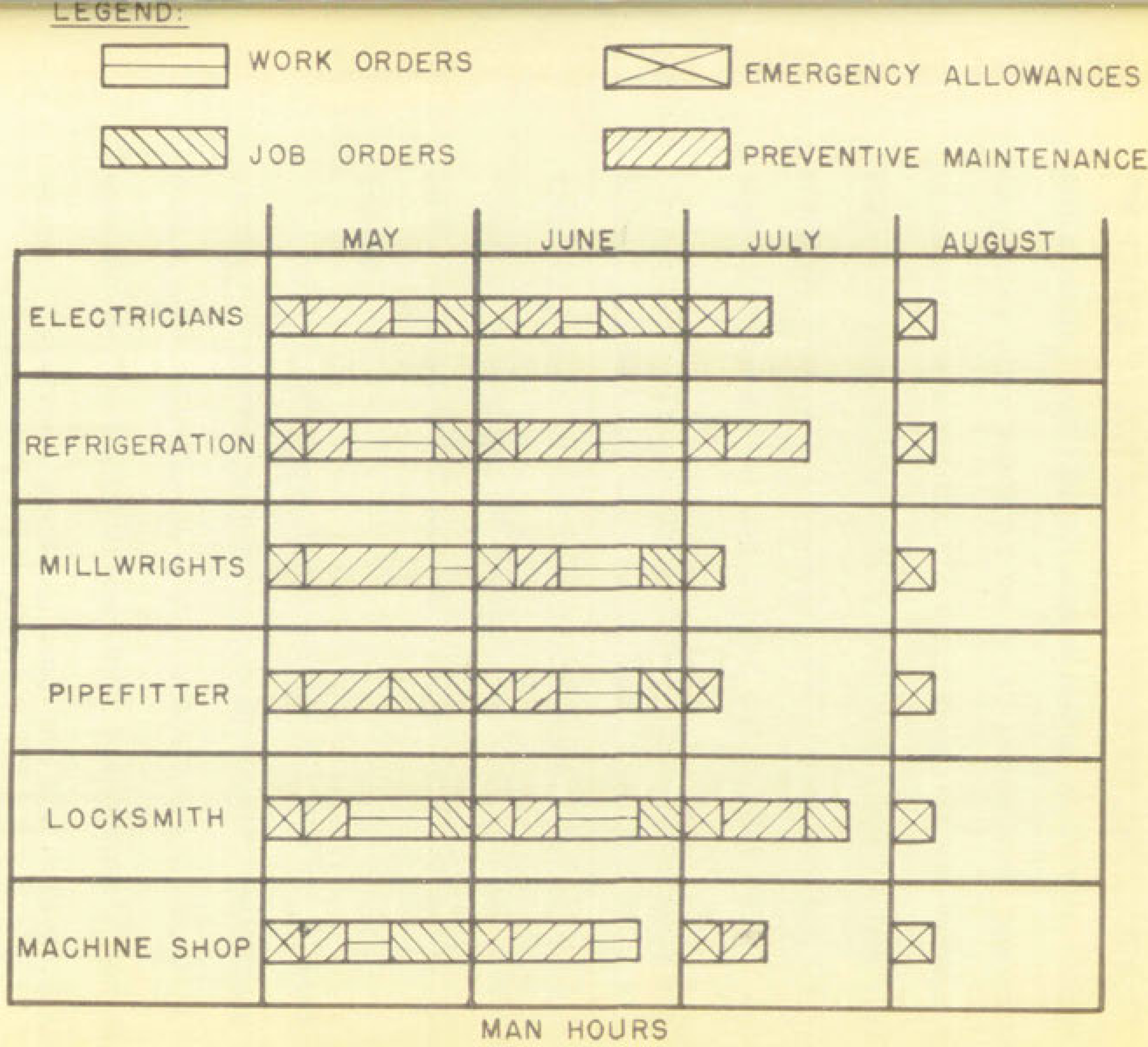

FIG. 1

LOAD CHART

Industrial concerns are now doing objective maintenance evaluation, along with some schools such as the University of Michigan, and they have drawn some interesting conclusions. Maintenance costs of 700 manufacturing companies were found to be 67.29 percent of the amount retained for net profit.[15] Therefore, if the amount spent for maintenance and repair had been less by twenty-five percent, even after allowing fifty-two percent of the savings for taxes, the net profit could have been increased by 8.07 percent. This does not take into account the additional production that would have resulted from less downtime by reason of better maintenance. As pointed out previously, a savings of twenty-five percent has been found to be a reasonable goal to attain, a fascinating prospect indeed.

In Oliver Wendell Holmes' narrative of an earlier century, "The Wonderful 'One-Hoss Shay'", one finds a twofold lesson for the need for effective maintenance. First, nothing is "so built it couldn't break down"; and second, unless a constant watch is kept for the evidences of a "general flavor of mild decay," disaster inevitably befalls.[16] Therefore, effective plant and equipment maintenance is prerequisite to efficient, low cost operation.

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[15] Techniques of Plant Maintenance and Engineering, p. 1.

[16] Louis Untermeyer (ed.), the Britannica Library of Great American Writing, Vol. I (Chicago: Britannica Press, 1960), p. 693.

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[15]*Techniques of Plant Maintenance and Engineering*, p. 4.

[16]Louis Untermeyer (ed.), *The Britannica Library of Great American Writing*, Vol. 1 (Chicago: Britannica Press, 1960), p. 693.

Preventive Maintenance

One of the prominent Directors of Physical Plants in a southern college wrote "preventive maintenance is an absolute must."[17]

> A survey of more than five dozen companies in a score of states shows that three out of every four are stepping up efforts to save money through preventive maintenance. They're inspecting and lubricating machines at carefully calculated intervals, working to develop trouble-free equipment, and setting up standards aimed at improving the efficiency of the maintenance workers themselves. . .
>
> John M. Line, maintenance chief at Western Electric Co.'s Burlington, N. C. plant says 'There's an almost untapped source of cost reduction in maintenance. If the same amount of management interest and modern techniques are applied to cutting maintenance costs as have been applied to production expenses, it would be relatively easy for most firms to reduce such costs by 20% to 25%. And that's a lot of money.' The Burlington plant cut its maintenance costs by 40% per production man hour in the last decade.[18]

Preventive maintenance is one of the economic "facts-of-life." Economics dominates maintenance evaluations. Perfect maintenance is too costly, and likewise, poor maintenance is too costly. However, application of the principles of management and proven maintenance procedures

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[17]Gene Stanford, "Surveying the Maintenance Programs of the Small School" (University of Tennessee, 1952), p. 3.

[18]The Wall Street Journal, Dow Jones and Company, Inc., March 7, 1961.

preventive maintenance

One of the prominent officers of Physical Plants in a southern college wrote approvingly [illegible] in its [illegible].[5]

> (a) A survey of [illegible] reported in [illegible] [illegible] through preventive maintenance. [illegible] [illegible] [illegible] equipment, and [illegible] aimed at improving the efficiency of the [illegible]...
>
> [illegible], maintenance [illegible] [illegible] [illegible] in maintenance [illegible] of management interest and [illegible] applied to [illegible] have been applied to production [illegible]. It [illegible] [illegible] [illegible] [illegible] [illegible] of money.' [illegible] [illegible] [illegible] the [illegible] [illegible].[6]

Preventive maintenance [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. Therefore, [illegible] of the [illegible] of maintenance and [illegible] [illegible] [illegible]

[5] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

[6] [illegible] [illegible] [illegible] [illegible]

will allow one to arrive at that point where optimum benefits arise from the least maintenance cost. On studying preventive maintenance, three facts are evident. First, day-to-day repairs are required to keep facilities in a safe and efficient operating condition. Second, repairs will fall into a repetitive pattern. And finally, repairs can be analyzed and a prediction made of what to do to prevent those repairs that economically justify prevention. Day-to-day repairs will always be required since the absolute prevention of all breakdowns might be more costly than occasional failures, and, also, no large scale prediction is ever perfect.

The guiding principle of preventive maintenance is that planned, periodic application of the correct maintenance service with systematic procedure will result in optimum equipment service and life. The desired results of the application of this principle are:

1. A reduction in the total cost of maintenance.
2. Fewer interruptions due to equipment failures.
3. A level maintenance workload and a stabilized workforce.
4. A predetermined and reduced inventory of material and spare parts.

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1. A reduction in the total cost of maintenance.

2. Fewer interruptions due to equipment failures.

3. A level maintenance workload and a stabilized workforce.

4. A predetermined and reduced inventory of material and spare parts.

Figure 2 attempts to show the relationship between the economic factors that determine the most profitable level of maintenance. The optimum point for preventive maintenance is somewhere in the middle. While there are no scales on the graph, the range of the level of maintenance varies from the uneconomic region on the left where there is no preventive maintenance, simply equipment failures, to the equally uneconomic region on the right where there would be constant preventive maintenance and no failures. The summation of the cost of preventive maintenance, the cost of repairs, and the cost of losses due to equipment failures yields the controllable maintenance cost. The desired level of preventive maintenance is then where the controllable maintenance cost is minimum. This minimum occurs, in theory, at the point where the cost of preventive maintenance is equal to the sum of the cost of repairs plus the cost of failures. A source of historical data, such as detailed maintenance records, will be necessary to determine the level of maintenance.

In summary, the following factors influence the level of preventive maintenance which an institution should try to attain:[19]

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[19] Techniques of Plant Maintenance and Engineering, p. 265.

Figure 3 attempts to show the relationship between the economic factors that determine the most profitable level of maintenance. The reference point for preventive maintenance is presented at the origin. [illegible] In general, the range of the level of maintenance varies from the uncontrolled region on the left where there is no preventive maintenance, simply equipment failure, to the totally uneconomic region on the right where there would be constant preventive maintenance and no failures. The summation of the cost of preventive maintenance, the cost of repairs, and the cost of losses due to equipment failures yields the controllable maintenance cost. The optimum level of preventive maintenance is that where the controllable maintenance cost is minimum. This minimum occurs, in theory, at the point where the cost of preventive maintenance is equal to the sum of the cost of repairs plus the cost of failures. A series of historical data, such as detailed maintenance records, will be necessary to determine the level of maintenance.

In summary, the following general indicators show the level of preventive maintenance which an installation should try to [illegible]

[illegible]

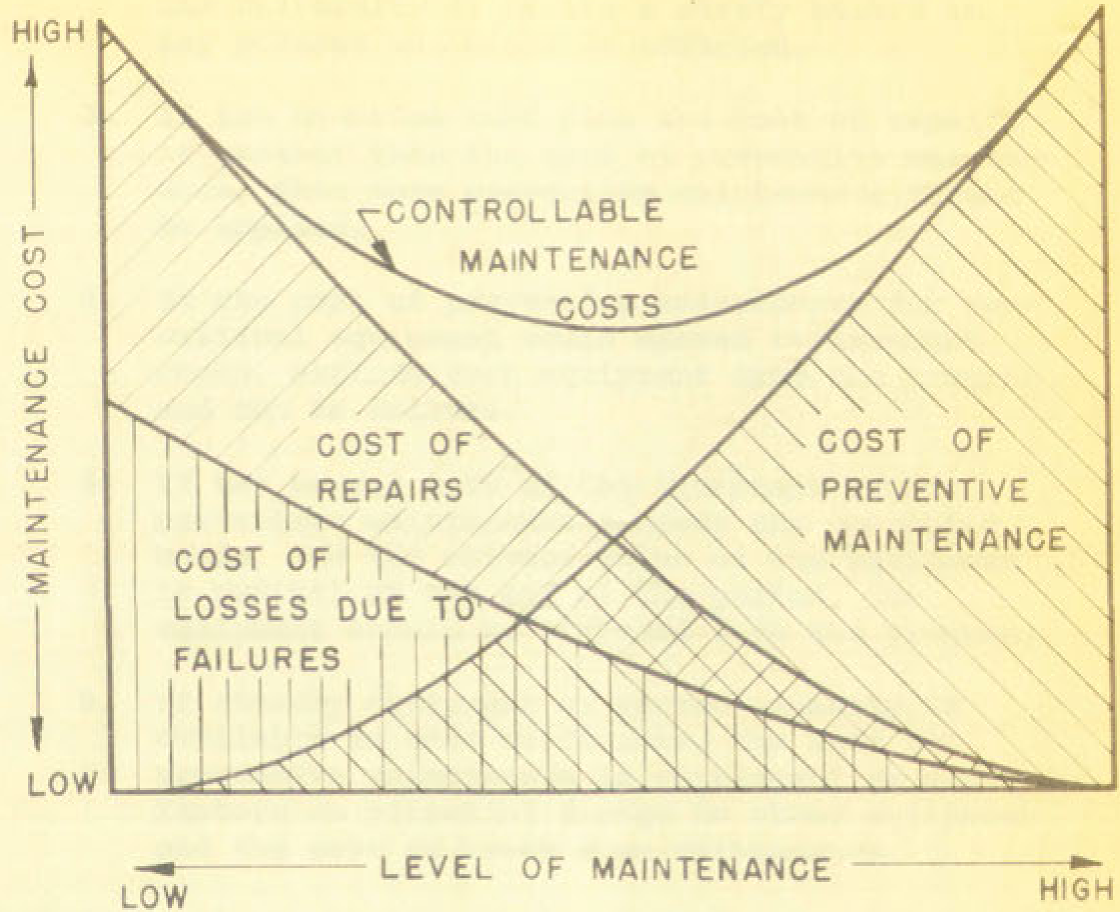

FIG. 2

PREVENTIVE MAINTENANCE

COST DETERMINATION

1. The preventive maintenance level should be high enough to prevent failures if such a failure would result in a sizable loss to the University or create a safety hazard to any persons who might be affected.

2. If the downtime cost plus the cost of repairs is greater than the cost of preventive maintenance, then more preventive maintenance should be applied.

3. If the cost of preventive maintenance for non-critical equipment would exceed replacement costs, exclude such equipment from the program and run to failure.

4. If the normal life of the equipment without preventive maintenance exceeds the operating needs, and the salvage value of the equipment is nominal at the end of the period, the equipment should be excluded from the program.

5. If standby equipment or unused capacity is available in case of failure, the need for preventive maintenance is contingent on such factors as potential damage to other equipment and the cost of break down maintenance.

Therefore, it can be seen that a high degree of human judgment must be exercised in calculating the risks, the potential hazards, and the weight to be given each of the above factors. It is also evident why cost accounting must go hand-in-hand with a good preventive maintenance program.

These factors are essential to an effective maintenance program. In light of this one should return to the preventive maintenance program at the University. The Buildings and Grounds Department does conduct a preventive maintenance

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

program to the extent that they lubricate various pieces of machinery on a prescribed schedule and paint metal surfaces. Economics are realized by replacing all light bulbs in a high ceiling room when one bulb is changed because of the ladders and scaffolding necessary. Also, when one washer in a plumbing fixture fails, all washers are replaced. To go a step further, however, industry has found that in an installation with the floor area of the University, it would actually save money to replace all light bulbs on a regular schedule whether they are burned out or not. The expense of the extra light bulbs is offset by the savings in the maintenance man's time.[20] The burning life of a fluorescent lamp is 18,000 burning hours, using conservative data.[21] The burning life could be affected by the number of times the bulb was turned on and off, a factor which could shorten the burning life considerably.

Another preventive maintenance cost saving that has recently been utilized by the Sandia Corporation has been the systematic replacement of compressors.[22] Compressors of all types are notoriously susceptible to breakdowns after they have been in service over some length of time. The

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[20] Interview with J. C. Hart, Sandia Corporation, June, 1961.

[21] Techniques of Plant Maintenance and Engineering, p. 59.

[22] Interview with J. C. Hart, June, 1961.

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Another preventive maintenance cost saving that has recently been utilized by the Sandia Corporation has been the systematic replacement of compressors.[22] Compressors of all types are notoriously susceptible to breakdown after they have been in service over a long period of time. The

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[20] Interview with J. C. Hart, Sandia Corporation, June, 1961.

[21] Techniques of Plant Maintenance and Engineering, p. 69.

[22] Interview with J. C. Hart, June, 1961.

manufacturers of this equipment were contacted, and the average running life of each compressor was obtained. When the compressor has been in service its average running life, it is sent back to the manufacturer for a rebuilt compressor. The trade-in value on this basis of replacement is sufficiently high that it has proved far more economical to replace the compressors than to try and repair them until they finally fail. Therefore, instead of spending money on preventive maintenance, or worrying about incomplete maintenance procedures, the University could operate under this compressor exchange system. There are enough air and refrigeration compressors and pumps of all types on the campus to justify such an arrangement.

The University does try to perform adequate preventive maintenance, but usually has to "rob Peter to pay Paul:" that is, with new construction, building renovation, and emergency service the department does not have time to carry through an adequate, systematic program. This situation should be remedied quickly, for adequate preventive maintenance is the backbone of any maintenance program, far more than is new construction. The only way to stop operating under the "Damocles' Sword" of emergency maintenance is to have an adequate preventive maintenance program.

Administrative Functions

In examining the organizational make-up of various physical plants departments around the country, the inconsistency in organizational structure is evident. Pat Boone sang a few years ago about "Bernardine": 'Your separate parts are not unknown, but the way you assemble them is all your own.'[23] Small schools use the "line" type of organization, while large schools use the "line and staff" type. A few schools conform more to the "line and functional" type of organizational structure.

Most physical plant organizations are broken down into five subdivisions:[24]

1. Planning
2. Office Functions
3. Building Maintenance Services
4. Utilities Operations
5. General Operations

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[23]Sam F. Brewster, Organizations and Functions of Physical Plant Departments of Universities and Colleges (Kansas State University: Manhattan, 1959), p. 1.

[24]Calvin C. Greene Jr., "Organization of a Physical Plant Division for Large Schools" (University of Florida: Gainsville, 1958), p. 2.

The various types of organizational structures previously mentioned are shown in Figures 3, 4 and 5 on pages 33 through 35. The names of the various organizational designs are derived from the channels of communication. A line organization is based on relative authority and responsibility rather than on the nature of the activities. Responsibility and authority are clearly defined through vertical communication. The functional plan has diagonal, overlapping lines of communication and authority. Line and staff organizations combine both the defined channels of responsibility and channels of communication from advisory groups.

The make-up of an idealized diagram purposely avoids delineation of detailed organizations within the several main functions, even though it is within this further detail that the difference between the large and small organizations will occur. Because of specialization, more expert workmen may be available to the large organization, but frequently, because of the greater difficulties of communication and supervision, the potential improvement due to this specialization may be reduced or lost altogether. However, in a smoothly functioning organiz-

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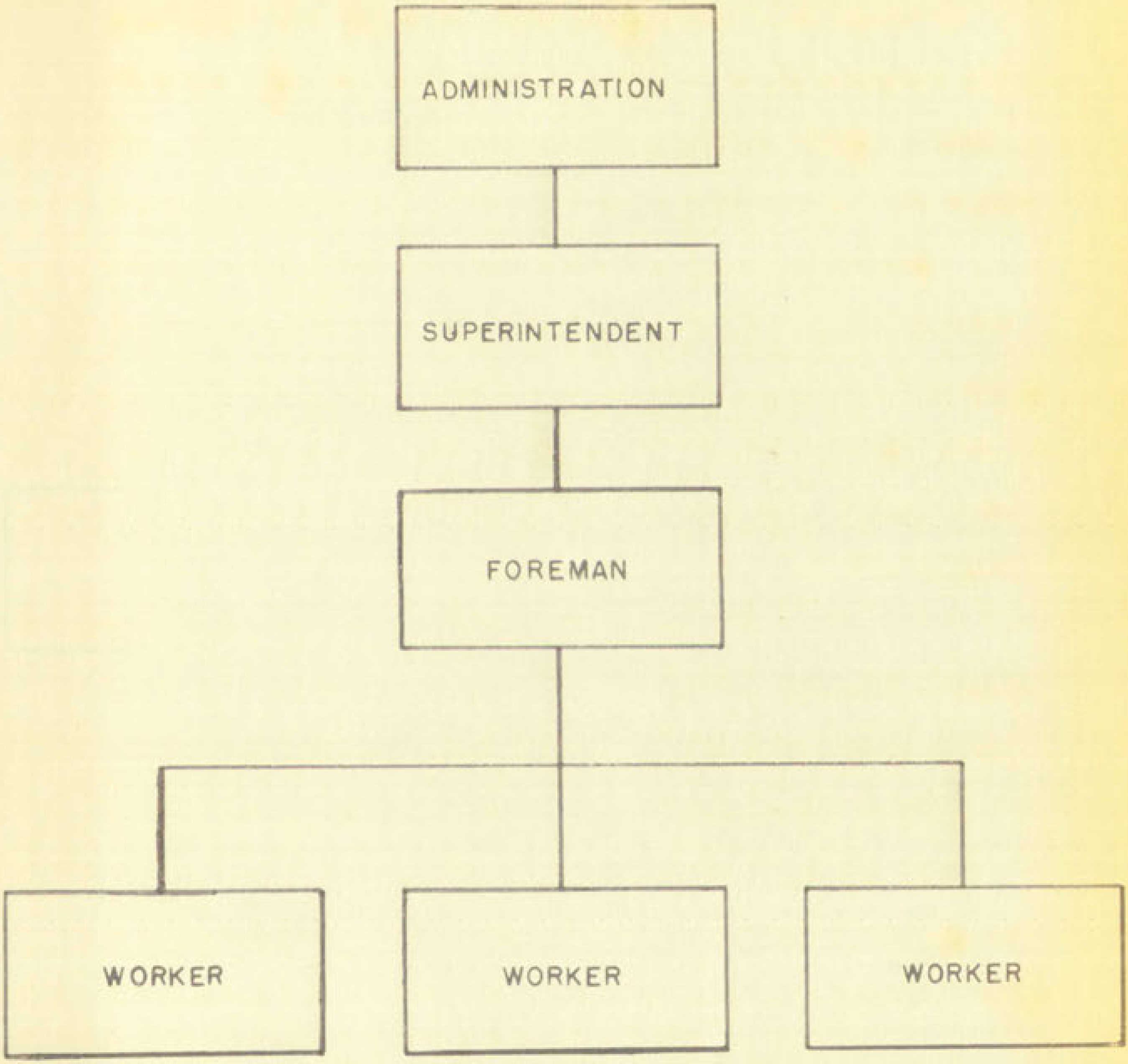

FIG. 3

LINE ORGANIZATION

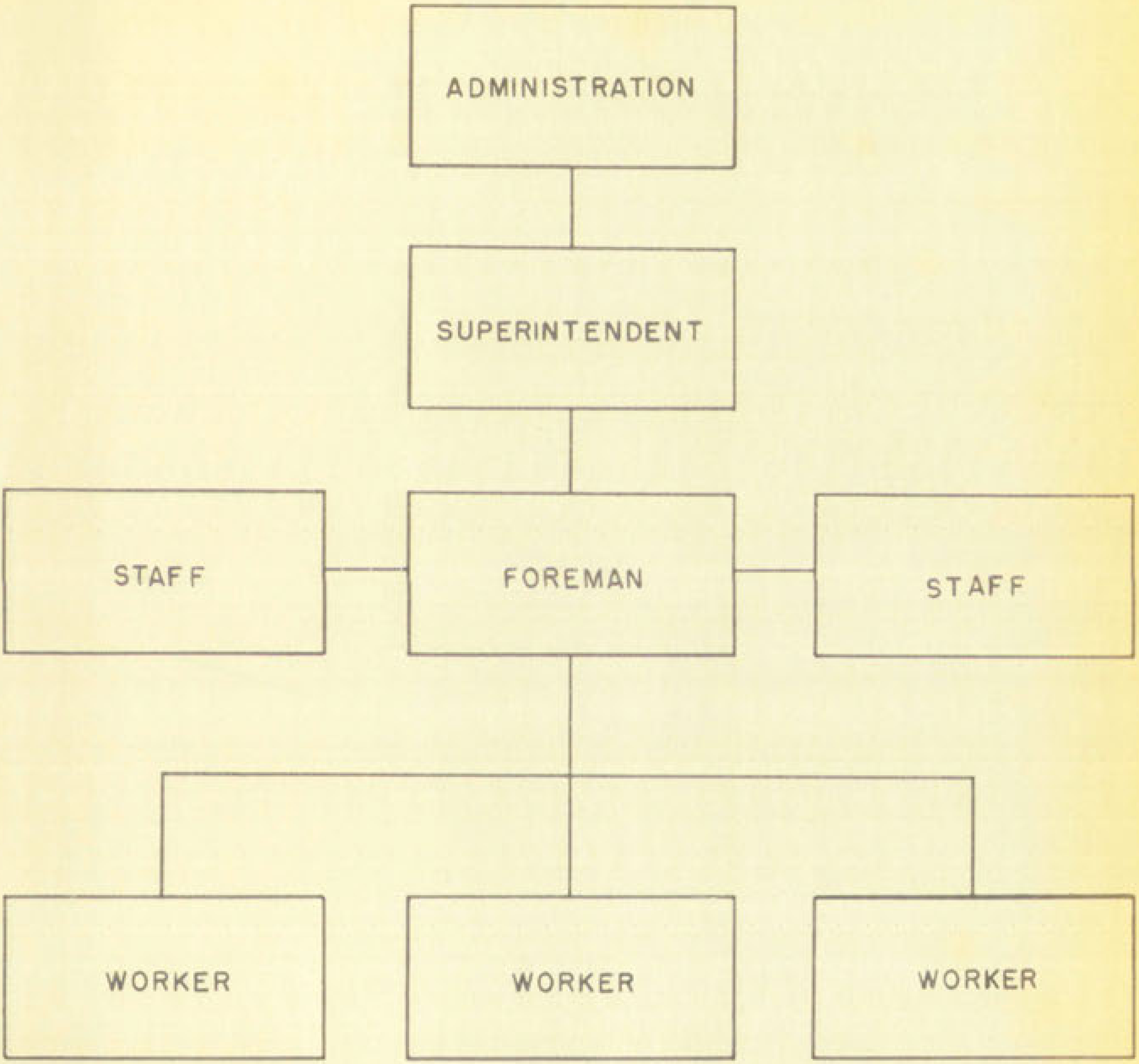

FIG. 4

LINE & STAFF ORGANIZATION

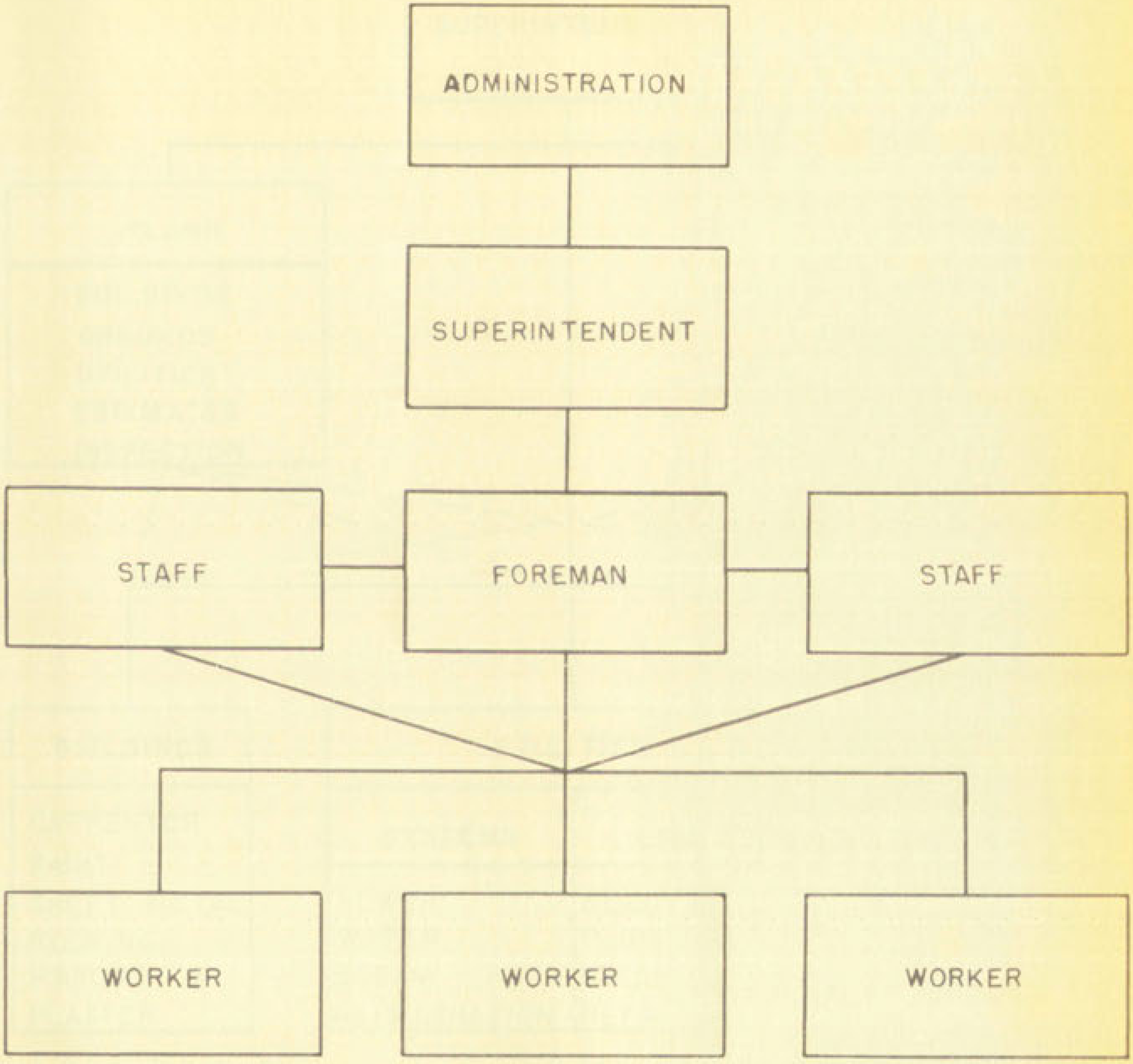

FIG. 5

LINE & FUNCTIONAL ORGANIZATION

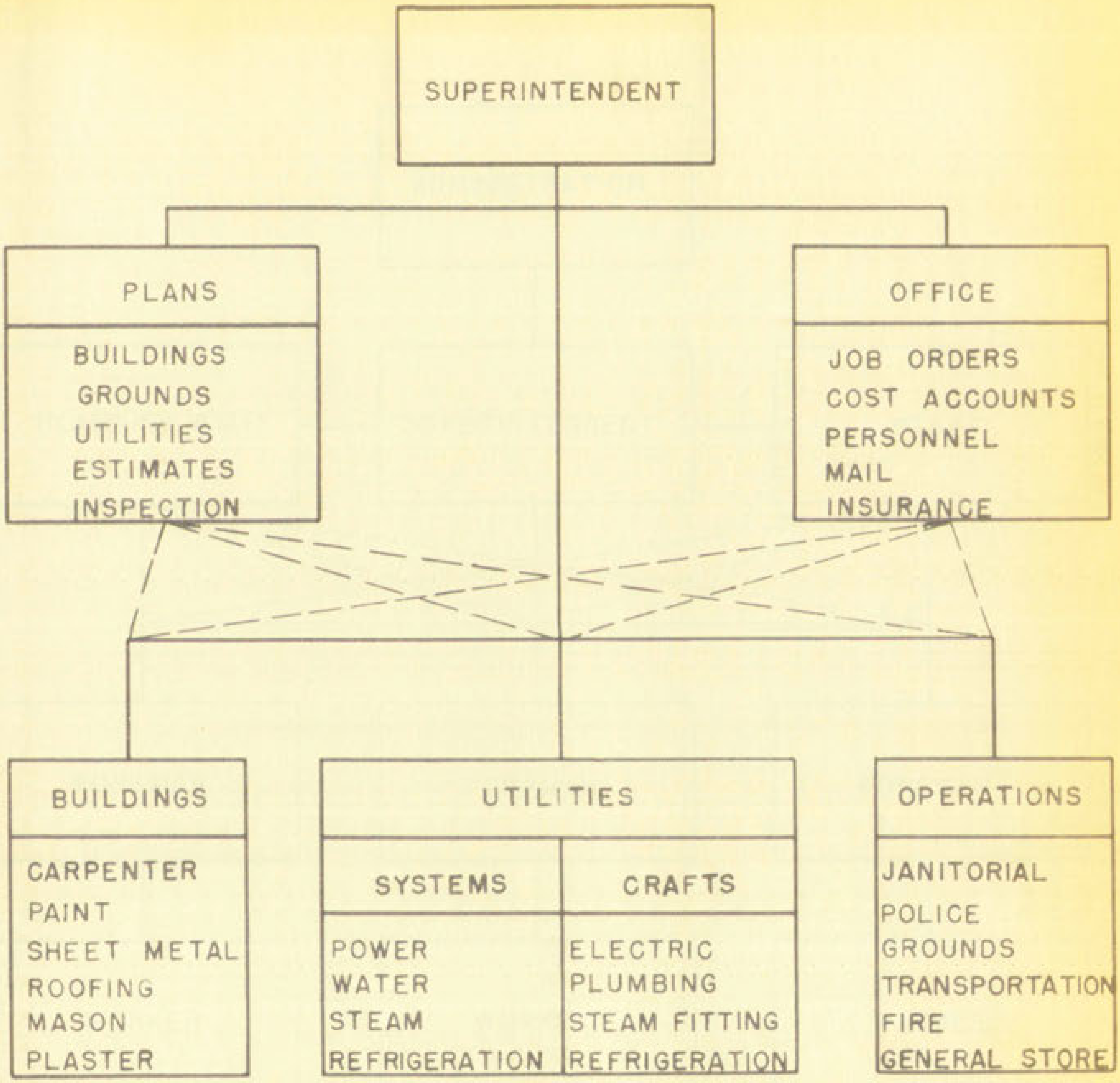

FIG. 6

IDEALIZED ORGANIZATION

FOR A

BUILDINGS AND GROUNDS DEPARTMENT

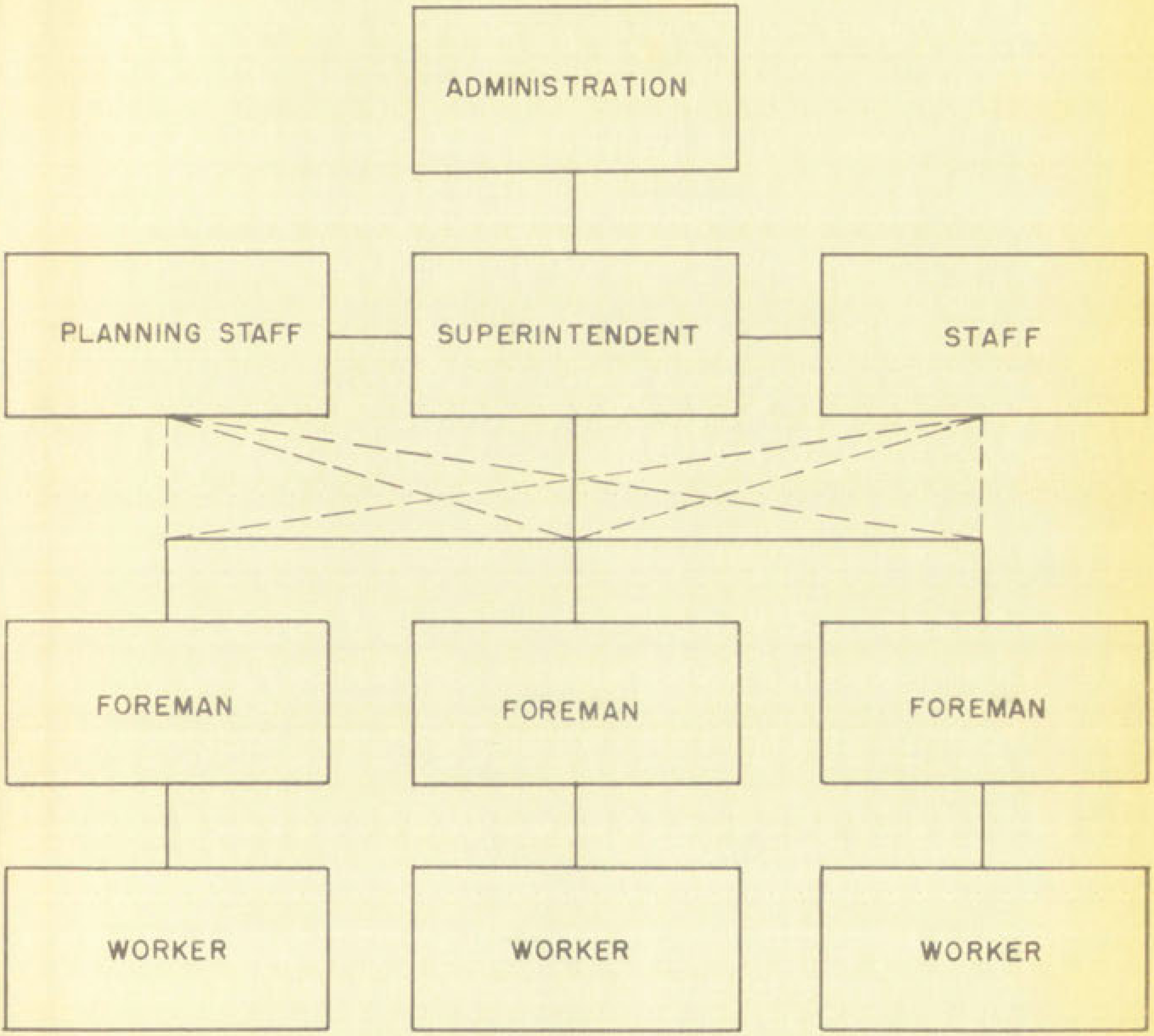

FIG. 7

PRESENT ORGANIZATION OF THE

BUILDINGS AND GROUNDS DEPARTMENT

ation, each operating department will maintain close liaison with staff departments and, although neither will take orders from the other, each will be guided in the conduct of its functions by advice from the other.

Figure 6 shows an idealized organizational chart in skeletal form. The Buildings and Grounds Department at the University is organized much like this, so that it has the potential ability to adapt itself to various situations with the minimum amount of disruptions.[25] However, time has a way of providing opportunities for effecting changes which can be for better or worse. Therefore, an ideal type organization should be devised and worked toward whenever the opportunity presents itself. An increase in operating efficiency should be the final result along with another worthwhile goal, that of gaining respect and cooperation from the rest of the campus.

"Waste and inefficiency cannot be detected and reduced quickly without adequate cost records."[26] This statement, while being true in this day of rapidly expanding university physical plants, is still enough to make most maintenance men shudder. They abhor paper work. However, the head of a

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[25]See Figure 7, page 37.

[26]F. D. Hobart, "Organization for Small Schools" (Davidson College: Davidson, 1958), p. 4.

ation, each specializing department will maintain close liaison with staff departments and, although neither will take orders from the other, each will be useful in the conduct of its function by advice from the other.

Figure 8 shows an idealized organizational chart in skeletal form. The Buildings and Grounds Department at the University is organized much like this, in that it has the potential ability to adjust itself to various situations with the minimum amount of disruption.[25] However, there may be a way of providing opportunities for effecting changes which can be for better or worse. Therefore, an ideal type organization should be developed and worked toward when the opportunity presents itself. Improvement in operating efficiency should be the final result along with another worthwhile goal, that of gaining respect and appreciation from the rest of the campus.

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[25]See Figure 7, page 37.

[26]F. E. Bennett, "Organization for Small Schools" (Davidson College: Publisher, 1958), p. 3.

large physical plant today finds that he spends more of his time in committee meetings, budget meetings, planning meetings, policy discussions and on administrative matters than he does rolling up his sleeves and getting the job done. Therefore, any tool which simplifies the over-all management job should be utilized.

Financial administration of projects is not exactly covered by the plans and specifications. Some will say that it is the accounting department's responsibility. However, accountants have a way of their own, and what is needed by a buildings and grounds department is a cost control system. Work must be justified by facts and figures and not simply by desires or opinions. A good maintenance control program establishes a systematic method of planning, organizing, and utilizing men, materials, and equipment to keep physical plants in good operating condition as economically as possible. Without proper cost records, a maintenance control program would be like the blind men and the elephant: everyone would draw a different conclusion because of a lack of information on the over-all picture.

A major function of cost accounting is the determination and analysis of costs and income of a business enterprise so that comparisons by divisions and periods of time can

large physical plant [illegible] [illegible] in general terms.

its [illegible] construction machinery, [illegible], [illegible],

[illegible], [illegible] and [illegible] [illegible]

can be done [illegible] the [illegible]

done. Therefore, any tool [illegible] [illegible] the [illegible]

value cannot be realized.

Financial administration of [illegible] [illegible] not [illegible] [illegible] by the [illegible] [illegible]. [illegible] may that it is the accounting department's responsibility. However, management [illegible] [illegible], and [illegible] the [illegible] by [illegible] and [illegible] in a cost control system. Such must be [illegible] by facts and figures and not [illegible] [illegible] or [illegible]. [illegible] control program [illegible] [illegible] of planning, [illegible], and [illegible] [illegible] both physical plant and [illegible] [illegible] as economically as possible. [illegible] maintenance control program [illegible] the [illegible]. [illegible]

[illegible]

in order to evaluate the operating efficiency of each division. Since another objective of a maintenance department is to maintain costs at the lowest possible point consistent with the most efficient operating conditions, the cost accounting function of accumulating and utilizing cost data is important. Costs must also match revenues, and each cost must be examined in light of the benefit obtained. Finally, special cost studies and investigations which are invaluable to management in determining policies and formulating plans directed towards economic operations are possible through cost accounting. The technique of cost accounting is the best tool by which management can evaluate the efficiency of an enterprise. By dividing costs into controllable and uncontrollable items, one could concentrate on those costs which might be reduced or eliminated.

> In general, it may be said that cost accounting is to serve management in the execution of policies and in the comparison of actual and estimated results in order that the value of each policy may be appraised and changed to meet future conditions.[27]

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[27] John Blocker and Keith W. Weltmer, Cost Accounting (New York: McGraw-Hill, 1954), p. 10.

in order to evaluate the operating efficiency of each division. Since another objective of a manufacturing department is to maintain costs at the lowest possible point consistent with the most efficient operating conditions, the cost accounting function of accumulating and utilizing cost data is important. Costs must also match revenues, and each cost must be examined in light of the benefit obtained. Finally, special cost studies and investigations which are invaluable to management in determining policies and formulating plans directed towards economic operations are possible through cost accounting. The technique of cost accounting is the best tool by which management can evaluate the efficiency of an enterprise. By dividing costs into controllable and uncontrollable items, one could concentrate on those costs which might be reduced or eliminated.

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The University needs a cost accountant in the Buildings and Grounds Department to prepare adequate records so as to properly evaluate maintenance procedures. Until this is done there is no accurate way of determining the level of maintenance efficiency. In a million dollar industry, a cost accountant would usually be considered a necessity; however, in most university maintenance departments they are looked upon as an unwanted mystic. Until the University installs a competent cost control recording system, improvements in maintenance efficiency will be based upon "hit-or-miss" methods unlikely to have a consistent success rate.

The need is beginning to be recognized. At the present time Mr. John A. Jacobson, Superintendent of the Physical Plant at the University, is working out the details of a cost control information sheet. This form will keep a running record of the various maintenance times spent on a particular building by each one of the maintenance crafts, along with a list of special peculiarities about that building and its equipment. This is a step in the right direction. The "piggy bank" control system (i.e. full or empty) cannot guide management forever. One of the most critical needs of the Buildings and Grounds Department is expansion of this beginning form into a sound cost control system.

Another factor which would help the cost control problem of Buildings and Grounds would be if each school, department, and/or division would operate under its own maintenance budget. If each faculty department would operate under a budget, there would be little or no misunderstanding as to what would be expected from the Buildings and Grounds Department. The particular school could use this budget to estimate the availability of funds for new construction, remodeling, or special maintenance. Such a budget would especially be applicable to schools and departments such as engineering, physical education, and others with special facilities. Buildings and Grounds would also have some tangible data with which to evaluate the feasibility of a particular desire of a school or department. An example of such a budget which has been successfully used at Davidson College can be found in Table 4 on page 43. While there would be an initial expense in compiling such a cost estimate and control system, it should not be excessively large. Cost records would also have to be kept so that a comparison of the budget and the actual expenditures could be made. If this arrangement could be established, it would prove to be beneficial to the whole University, and especially to Buildings and Grounds. Mr. Jacobson agreed on this point, and he mentioned that he has felt for some time that such a budgeting procedure was necessary.

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TABLE 4

DAVIDSON COLLEGE EXPENSE BUDGET[a]
1958-59

II. Auxiliary Enterprises (5)

A. Dormitories (51)

Item		Account Number	Actual Budget 1957-58	Approved Budget 1958-59
(a)	Salaries	5101	$ 3,000.00	$ 3,500.00
(b)	Annuity	5102	58.32	-0-
(c)	O.A.S.I.	5103	791.35	1,000.00
(d)	Wages, Repairs	5104	6,472.83	8,000.00
(e)	Supplies, Repairs	5105	4,934.54	4,500.00
(f)	Wages-Janitors	5106	25,810.64	27,500.00
(g)	Supplies-Janitorial	5107	3,877.77	3,800.00
(h)	Contractual	5108	2,476.60	4,000.00
(i)	Heat	5109	13,518.60	14,500.00
(j)	Light	5110	7,113.00	7,600.00
(k)	Water	5111	1,782.83	2,050.00
(l)	Insurance	5112	1,404.80	1,950.00
(m)	Equipment	5113	1,516.40	2,460.00
(n)	Telephone	5114	1,281.06	1,650.00
(o)	Laundry	5115	291.14	250.00
(p)	Office Supplies	5116	117.98	100.00
(q)	Miscellaneous	5117	57.52	200.00
	Total-Dormitories		$74,505.38	$83,060.00

[a]F. D. Hobart, "Organization for Small Schools" (Davidson College: Davidson, 1958), p. 16.

Another process that functions simultaneously with a cost control program is scheduling of maintenance personnel. Maintenance management must seek improvement through better planning and scheduling, a more consistent method of applying priorities to jobs, and more systematic estimates of manpower and material requirements. It is also generally recognized that there is too much emergency or rush maintenance and too little preventive maintenance. The pressure of heavy workloads has left the University's Buildings and Grounds Department with little time to develop tangible data either to prove the value of their programs or bring home forcibly the fact that something was wrong. Too often only the "squeaky" wheel gets the grease.

A maintenance plan that can anticipate eighty percent or more of the work to be done in a given day is better than no plan at all. Such a plan would still allow time for emergencies. To put such a plan into graphical form, a form which is quite useful in scheduling, a Gantt chart, Figure 8, could be used or a chart like Figure 1, page 22. The hypothetical chart shown would give management an indication of the labor available in any given month. Weekly and daily scheduling may be broken down from this over-all view so as to properly utilize the workers.

Another process that requires special study with a cost control program is scheduling of maintenance personnel. Maintenance management must seek improvement through better planning and scheduling, a more systematic method of assigning priorities to jobs, and more systematic estimates of manpower and material requirements. It is also generally thought that there is too much emergency or crash maintenance and too little preventive maintenance. The pressure of heavy workloads has left the University's buildings and grounds department with little time to develop long-range plans, [illegible] to prove the value of their programs or being able [illegible] that something was wrong. Too often only the [illegible] wheel gets the grease.

A maintenance plan that can anticipate eighty percent or more of the work to be done in a given day [illegible] no plan at all. Such a plan would still allow for emergencies. To put such a plan into [illegible] which is quite useful in scheduling [illegible] would be used in a chart like Figure [illegible] [illegible]

LEGEND:

DATE WORK IS TO BEGIN

DATE WORK IS TO BE COMPLETED

8 AMOUNT OF WORK TO BE COMPLETED BY DATE SHOWN

WORK SCHEDULED

WORK SCHEDULED & COMPLETED

CURRENT DATE

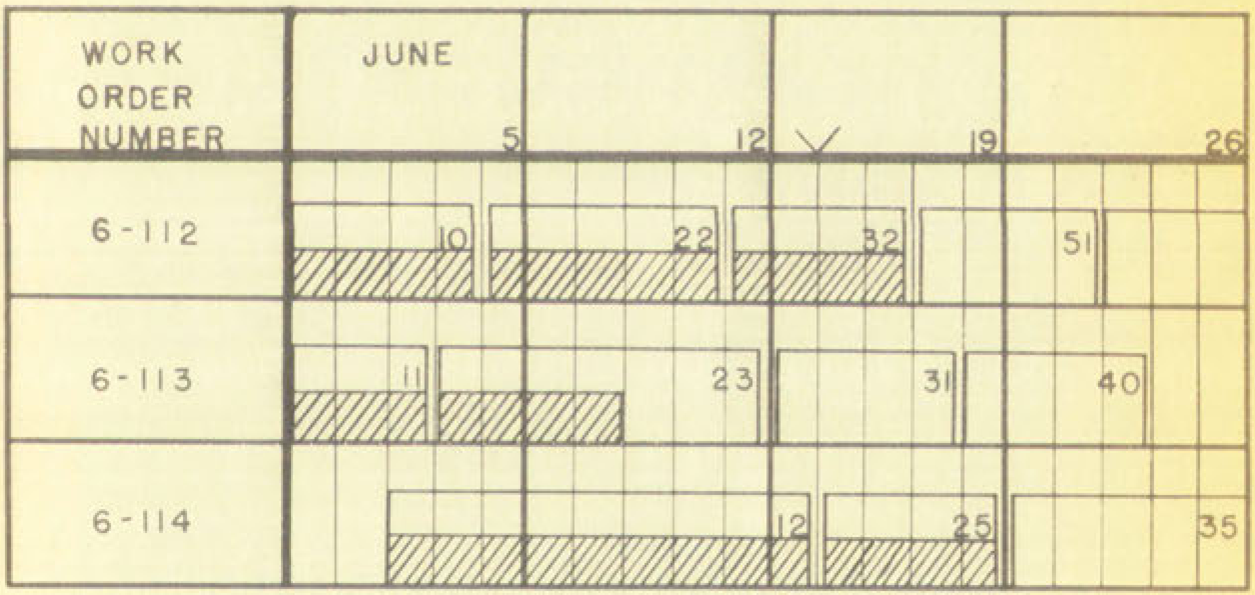

FIG. 8

GANTT PROGRESS CHART[A]

[A] ADAPTED FROM EDWARD H. BOWMAN AND ROBERT B. FETTER, ANALYSIS FOR PRODUCTION MANAGEMENT (REV. ED.; HOMEWOOD, ILLINOIS: RICHARD D. IRWIN, 1961,) P. 59

Another method of attacking the scheduling problem would be analytical method. Whenever the service must be provided to meet some demand which is in any way irregular, an economic decision problem exists. The administrator must decide on the level at which he is to provide this service. There are two popular methods of analysis which could fit this problem. The first method of analytical scheduling uses probability tables. The second uses the Monte Carlo simulation. Simulation could be defined as a system which has assumed the appearance of another system without reality. Simulation, therefore, takes a real system and duplicates it.[28] Because simulation focuses on certain characteristics of a system, by implication, it largely ignores the others. This allows one to examine varying alternatives to see which combination will give optimal results. These new systems of scheduling are of interest; however, the basic concept

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[28]An example will be presented to illustrate the Monte Carlo method of analysis on a maintenance problem. This has been adapted from Bowman and Fetter's Analysis for Production Management.

A chemical company has a series of high-pressure injection pumps operating under similar conditions and wishes to determine a proper maintenance policy. The pump valves are subject to failure, and their routine maintenance costs about 9,500 man-hours per year. Each pump has three intake valves and three exhaust valves. When a valve fails, it is necessary to shut down the pump and prepare it for maintenance. Each set of valves is covered by a manifold which must be removed after shutdown in order to expose either the three intake valves or the three exhaust valves. There is no downtime cost as the

Another method of attacking the scheduling problem would be analytical methods. Whatever the method, a path must be provided to reach some target which, as it may vary irregularly, an economic decision problem occurs. The administrator must decide on the level at which he is to provide this service. There are two popular methods of analysis which could aid this problem. The first method of analytical scheduling uses probability tables. The second uses the Monte Carlo simulation. Simulation could be defined as a system which has assumed the appearance of another system without reality. Simulation, therefore, takes a real system and duplicates it.[28] Because simulation focuses on certain characteristics of a system, by implication, it largely ignores the others. This allows one to examine varying alternatives to see which combination will give optimal results. These two systems of scheduling are of interest; however, the basic concept

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of scheduling must first be sold before any exotic systems are installed.

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firm has stand-by pumps to be used during maintenance on the valves.

The company wants to evaluate four maintenance procedures which it considers practical:

1. Repair a valve only when it fails.
2. Repair all three exhaust valves if one exhaust valve fails, or repair all three intake valves if one intake valve fails.
3. Repair all six valves (three intake and three exhaust valves) whenever a pump must be shut down to repair one valve.
4. Repair the valve that fails plus all valves which have been in use more than the estimated average service life (560 hours).

The first step in the Monte Carlo analysis was to find the maintenance cost, expressed in mechanic's time, for each operation necessary to repair the pump. A cumulative probability distribution was also constructed from empirical data supplied by the company. Using the cumulative probability distribution, random numbers, representing decimal values of the probability, were applied in order to simulate experience. The random numbers thus generated a table showing a series of valve lives corresponding to each valve if the valve remained untouched until failure. The generation of random numbers gives the Monte Carlo analysis its name. This simulated experience for each valve is plotted for each of the four alternative maintenance policies previously listed.

A cost analysis for the first 2,300 hours was made. The number of times the different maintenance operations were performed was counted for each of the four alternatives and these times were related to the total maintenance cost of each maintenance procedure. In this particular case, the first alternative was found to be the least expensive since the total maintenance time was only 75 hours as opposed to 98.58, 205.3 and 81.17 for the other alternatives. This is a valuable conclusion, for the first method required the greatest number of shutdowns; however, the overhaul time was not as extensive after shutdown. Additional cost information and data on other factors would make such a simulation more complete. The Monte Carlo method is most helpful where a more formal mathematical method of analysis is not possible or convenient.

of scheduling must first be told before any [illegible] systems are installed.

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find best stand-by pumps to be used during maintenance on the valves.

The company wants to evaluate four maintenance procedures which it considers practical:

1. Repair a valve only when it fails.
2. Repair all three exhaust valves if one exhaust valve fails, or repair all three intake valves if one intake valve fails.
3. Repair all six valves (three intake and three exhaust valves) whenever a pump must be shut down to repair one valve.
4. Repair the valve that fails plus all valves which have been in use more than the estimated average service life (800 hours).

The first step in the Monte Carlo analysis was to find the maintenance cost, expressed in mechanic's time, for each operation necessary to repair the pump. A cumulative probability distribution was also constructed from empirical data supplied by the company. Using the cumulative probability distribution, random numbers, representing decimal values of the probability, were applied in order to simulate experience. The random numbers thus generated a table showing a series of valve lives corresponding to each valve if the valve remained unattended until failure. The generation of random numbers gives the Monte Carlo analysis its name. This simulated experience for each valve is plotted for each of the four alternative maintenance policies previously listed.

A cost analysis for the first 2,500 hours was made. The number of times the different maintenance operations were performed was counted for each of the four alternatives and these times were related to the total maintenance cost of each maintenance procedure. In this particular case, the first alternative was found to be the least expensive since the total maintenance time was only 72 hours as opposed to [illegible] for the other alternatives. This is a reasonable conclusion, for the first method requires the [illegible]

At the present time the University's Buildings and Grounds Department uses only the rudiments of scheduling, and while even that helps a great deal, a complete scheduling system could do much to increase worker efficiency. The workmen in the Buildings and Grounds Department are paid on a portal-to-portal basis: that is, their pay starts before they are transported to the main campus for their jobs. Since they are then transported from job to job, the waiting time alone would add up to a considerable man-hour load. At present a list of jobs is compiled in order of descending priority, along with pertinent details and the names of the maintenance worker in charge. This chart is approved by the campus planning committee and sent out to the faculty and administrative personnel concerned. While this gives the work a sense of direction, it still allows for gross inefficiencies.

At this point, a brief explanation of the composition of the campus planning committee would be in order. There is actually no campus planning committee as such. There are three separate committees that aid the Buildings and Grounds Department in the scheduling of campus construction. The major scheduling committee is the Master Campus Plan Committee.

At the present time the University's buildings and [illegible] grounds department uses [illegible] and while [illegible] [illegible] [illegible] [illegible] they are [illegible] Since they are [illegible] [illegible] present [illegible] [illegible], along with [illegible] maintenance [illegible] campus planning [illegible] administrative personnel [illegible] with a sense of [illegible] [illegible].

At this point, [illegible] the campus [illegible] [illegible] [illegible] [illegible] [illegible]

The members of this committee are Dr. H. L. Enarson, M. F. Fifield, Dr. S. E. Smith, John Perovich, Prof. Don Schlegel, J. A. Jacobson, Floyd Williams, John Durrie, and Prof. M. C. May.[29] This committee is presently revising the various components of Warnecke's General Development Plan for the Campus of the University of New Mexico. The second scheduling committee is the Campus Planning Committee composed of Dr. H. L. Enarson, M. F. Fifield, Dr. S. E. Smith, John Perovich, J. A. Jacobson and John Durrie.[30] This group is responsible for the actual month to month scheduling of construction and renovation projects. Finally, the Building Committee is rather loosely composed of the Buildings and Grounds Department and the particular faculty members involved in the construction. Unfortunately, the University does not have its own architect to properly plan and coordinate the various phases of construction about the campus. The need was brought out in the General Development Plan. Such an addition to the staff should be a definite aid in proper scheduling.

Scheduling, however, is not the only factor which improves an organization's efficiency. Therefore, as a summarization of

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[29]Interview with John A. Jacobson, August, 1961.

[30]Ibid.

The [illegible] of [illegible] position [illegible] [illegible] commonplace,

[illegible] [illegible] [illegible], [illegible] [illegible], [illegible],

H. [illegible] [illegible] [illegible] [illegible] [illegible],

M. [illegible].[24] This [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] of [illegible] principles [illegible] [illegible] for the

[illegible] in the [illegible] of the [illegible]. The [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] A.

H. [illegible], [illegible], [illegible], [illegible] [illegible],

J. [illegible] and [illegible] [illegible].[25] This group [illegible] [illegible]

for the [illegible] [illegible] [illegible] of [illegible] [illegible]

conservation [illegible] [illegible], [illegible] [illegible] [illegible]

loosely composed of the [illegible] and [illegible] [illegible]

the [illegible] [illegible] [illegible], [illegible] the [illegible],

[illegible], the [illegible] [illegible] [illegible] [illegible] [illegible]

to [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] and [illegible] [illegible].

[illegible], however, [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible], [illegible] [illegible]

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[24] [illegible] [illegible] [illegible], [illegible], [illegible]

management's task to improve maintenance quality and efficiency, the following list of recommendations fits rather well.

1. Develop/ment/ and install/ation of/ administrative controls (listing routine jobs and a work order system.
2. Development and installation of procedures for controlling and scheduling manpower, equipment, and materials.
3. Development of a system of record keeping for plant use that would facilitate filing, compiling, and tabulation of information useful in analyzing and improving the maintenance function. This information would include data that would make possible: (a) cost control; (b) improved preventive maintenance; (c) planning of manpower and equipment requirements; (d) better budgeting; (e) improved maintenance methods and techniques.
4. Development of standards.
5. Development of a system of materials control.
6. Development of a system of reports to the various levels of management to portray the status of the maintenance activity.[31]

In an actual industrial case, the following benefits were accrued from such a program:

1. Clarification of organization relationships and functions, which resulted in the lessening of personality and jurisdictional clashes.
2. Provision of standards which, with the routinizing of various types of maintenance workloads, has made it possible for the plant to plan its day-to-day work, measure its effectiveness, and program its future workloads.
3. Provision of data that can now be analyzed by those most familiar with the operation to make possible--

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[31]Techniques of Plant Maintenance and Engineering, p. 152.

management's task to improve maintenance quality and efficiency, the following list of present maintenance [illegible].

1. Development[1] and installation of maintenance controls (including budgets, cost and performance systems).
2. Development and installation of a system for controlling and scheduling manpower, equipment, and materials.
3. Development of a system of records covering the plant and equipment in addition to history, record keeping and tabulation of data which would be used in analyzing and improving the maintenance function. This information would include such items as: (a) cost control; (b) improved preventive maintenance; (c) planning of manpower and equipment requirements; (d) better scheduling; (e) improved maintenance methods and techniques.
4. Development of standards.
5. Development of a system of maintenance control.
6. Development of a system of reports to the various levels of management to inform them of the status of the maintenance activity.

In an actual industrial case, the following specific needs derived from such a program:

1. Clarification of organizational relationships and functions, which will lead to the lessening of personality and jurisdictional disputes.
2. Provisions for adequate definition, which, with the centralizing of work authority in maintenance, will enable the plant to plan its day-to-day work, [illegible] available.
3. [illegible]

[1][illegible]

a. Cost reduction through better work methods and techniques.
b. More effective planning for the better utilization of new equipment and materials, and for a flexible workforce of the proper size.
c. Work scheduling that insures routine, rush, and non-rush work is done in the proper sequence and provides a steady flow of work to workmen.

4. Establishment of standards for evaluation of staff performance as it relates to maintenance.
5. Creation of an awareness on the part of the foremen and supervisors that in this era of technological advances, tight labor markets, and sensitive labor relationships, more than technical qualifications are required to direct the activities of maintenance groups, large or small.[32]

These benefits have actually been realized in industry and they could be realized at the University of New Mexico if an adequate system of maintenance controls were initiated.

Personnel

The University has been fortunate in the type of labor it has been able to recruit for its maintenance staff--fortunate because in general the University pay scale is below the prevailing wage rate in Albuquerque (see Table 12). Political pressure also results in hiring some dubious individuals at times; so the department has a ninety-day trial period, in which any employee hired may be discharged for unsatisfactory

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[32]Ibid., p. 155.

performance. Giving the unsatisfactory worker a chance does not always help the superintendent. It may just prolong the day of dismissal.

Employee retention by the Buildings and Grounds Department has been excellent. The turnover rate of the skilled trades was 11.4% in 1960, while the turnover rate in the custodial and grounds crew was sufficiently high; to bring the 1960 turnover in the Buildings and Grounds Department to approximately 13.3%.[33] These turnover rates were calculated as follows:

1. Add the accessions and the separations.
2. Divide the total by two.
3. Divide by the number of workers at the end of the period.
4. Multiply by 100.[34]

This formula gives a fairly true representation of the turnover since the information obtained from Mr. Jacobson showed that there has been no major expansion or decline in the labor force.

Since maintenance work is scattered all over the University, the maintenance men must work most of the time without supervision; therefore, they must be quite dependable. If one assumes for the moment that the employees presently employed are sufficiently capable and industrious to handle

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33 Information on employee accessions and separations and also the total number of employees was obtained through an interview with John A. Jacobson, August, 1961.

34 Richard N. Owens, Management of Industrial Enterprises, Fourth edition (Homewood, Illinois: Richard D. Irwin, 1961, p. 501).

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an effective maintenance program, a reasonable assumption, the problem is then how to properly stimulate and aid the workers to derive the maximum practical operating efficiency.

It has often been said that a worker is no better than his tools; however, an untrained worker will get primitive results with the finest equipment. At the present time the only workers receiving any formalized training from the University's Buildings and Grounds Department are the custodians. The new janitors are put in several small buildings such as the Counseling and Testing Building or the Bureau of Business Research to work under experienced custodians before they are given their own assignments on the campus. The department already has personnel qualified to teach any necessary courses, so that the only problem would be to take the time to conduct courses.

The workers should be able to do a more capable job if they know some of the theory connected to their particular crafts or possibly what some of the latest methods are. Very few plumbers, for example, know the reasoning behind pipe size selection. This has resulted in improper piping of radiators. Plumbers have a tendency to always use the same size of pipe when installing a radiator rather than adjusting the pipe size to the heat output rating of the radiator.

so distinctly points to the [illegible], a comprehensive [illegible], the [illegible] plan is then one to properly [illegible] and ask the workers to [illegible] the modern [illegible] practical [illegible] efficiency.

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The [illegible] should [illegible] that some of the [illegible] in [illegible] particular [illegible] [illegible] their [illegible].

[illegible]

Greater knowledge of heating and air conditioning would result in a more satisfactory finished job. The inspector's job would be simplified also. Just having the proper pipe size on a blue print is no assurance that the same size will be installed. Electricians also have a similar problem in selecting the proper size of wires to pull in a conduit to handle a given power load requirement. It is quite possible that if the workers had additional background knowledge of their jobs, the workmen might be better able and more willing to effectively carry out a given task. Moreover, the training program should be of a continuous nature with periodic "refresher" sessions. These should add to both efficiency and worker morale by "brain storming" various trouble spots.

Texas Technological College has developed an extensive training program, complete with all varieties of teaching aids. This program has been quite successful, and by using the visual aid system combined with demonstrations, it has solved the old problem of the new worker immediately learning the existing bad habits. To be successful, this program must be given to people who are able to follow written and oral instructions. Obtaining this type of worker is not always as simple as it might seem. The average janitor is a man past

his prime who has never been particularly successful and who is now on the down grade. Often the labor force is drawn from a group which is not highly skilled or qualified and is not easy to teach.

Since training is so important to an efficient and properly done job, such fundamentals of a sound training program as the following must be applied:

1. Determination of the objectives of the training program.
2. Flexibility of the course content and teaching methods.
3. Development of the training program.
4. Selection of the trainees.
5. Establishment of adequate records to indicate the effectiveness of the training program.
6. Follow-up of the results and translation of these results into improvements in the training program.

As an additional benefit derived from a good training program, the employee retention rate after proper training and indoctrination can be quite high. Firestone Tire and Rubber Company has a ninety percent retention rate among its maintenance trainees. This retention rate is not attributable

his person who has never been particularly successful and who is new on the assignment. Often the sales force is drawn from a group which is not highly skilled or qualified and is not easy to train.

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1. Determination of the objectives of the training program.
2. Flexibility of the course content and teaching methods.
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6. Follow-up of the results and translation of these results into improvements in the training program.

As an additional benefit derived from a good training program, the employee enhances even after proper training and indoctrination [illegible] right. [illegible] and cannot [illegible] they may have a timely [illegible] the [illegible]

to the training program alone, however. Many other factors affect the employee turnover rate at Firestone, such as extra pay and extra attention to the morale of the maintenance workers. Moreover, the majority of the maintenance workers are skilled machinists whose turnover at Firestone has always been low. Finally, the fringe benefits and working conditions are better than the average company in Firestone's geographical location.[35] These factors still do not discount the fact that a well conducted training program is an excellent medium through which to sell the company and its program and benefits.

Increases in direct labor efficiency in industry have been very lucrative and relatively easy to accomplish. Management in industry has recently begun to achieve the same improvements in the efficiency of indirect labor by using the techniques of industrial engineering. Webster defines "technique" as "the expert way of doing a task." Industrial engineering is a frame of mind--a conviction that the real way to find the best method is to break down an operation into its components and gather sufficient facts about the operation for an adequate evaluation. The details are then fitted together to form the best method, which will be the one that is easily understood, evaluated and sold. Improvements in method require some real

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[35] _Techniques of Plant Maintenance and Engineering_, p. 14.

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[35]Techniques of Plant Maintenance and Engineering, p. 15.

digging, because if they had been easy, they would have already been done.

One industrial engineering technique now receiving widespread use is "work sampling." This involves random observations to determine where the "bottle-necks" are in an operation. Delays are not only costly but also have an adverse effect on morale. This sampling does not try to single out a particular worker, but rather it tries to determine how the average worker spends his time.

Another new evaluation tool is memomotion. Just as a football coach studies last Saturday's movies of the game, memomotion is a method of studying main movements by motion picture. These can greatly increase worker efficiency by careful study. Using motion pictures, one has a more accurate record of interrelated events than is possible with visual observation. Since the camera runs at a constant film speed of fifty, sixty or one hundred frames per second, the attention is focused upon an accurate work record of the major movements of the job. This method is still, of course, only an aid to analysis.[36]

To use industrial engineering techniques effectively, the administration must be in genuine agreement on the need

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[36]Additional information on this method of analysis may be found in <u>Techniques of Plant Maintenance and Engineering</u>, p. 57.

digging, because if they had been easy, they would have already been done.

One industrial engineering technique now enjoying widespread use is "work sampling." This involves random observations to determine where the 'bottle-necks' are in an operation. Delays are not only costly but also have an adverse effect on morale. This sampling does not try to single out a particular worker, but rather it tries to determine how the average worker spends his time.

Another new evaluation tool is memomotion. Just as a football coach studies last Saturday's movies of the game, memomotion is a method of studying work movements by motion pictures. These can greatly increase worker efficiency by careful study. Using motion pictures, one has a more accurate record of uncontrolled events than is possible with visual observation. Since the camera records at a constant slow speed of fifty, sixty or one hundred frames per minute, the operation is [illegible] an accurate time record of the major movements of the job. This method is still, of course, only in its infancy.

To use industrial engineering techniques effectively, the administration must be [illegible]

[illegible]

for improvement. It is mainly necessary to study the larger worker groupings such as the custodians since it would probably not be economical at the present time to study all the areas of the University's maintenance program. A minimum of fear and suspicion on the part of the maintenance employee is necessary also. This fear should be eliminated by a proper explanation of what the program is trying to accomplish and how the test and evaluations will be made. It should also be reemphasized that this would not be a program to single out a particular worker nor drastically reduce the workforce. Rather, the program would strive to increase the quality of performance and increase the amount of administrative satisfaction with the maintenance program and reduce the cost to the University. Along with the industrial engineering techniques discussed, the improvements previously mentioned such as employee training and scheduling must be made concurrently to achieve maximum results.

Comparison with Other Maintenance Operations

This paper has covered various suggestions on improving the University's maintenance program by suggesting techniques which have proven successful in industrial applications. Interspersed with these concepts were also ideas derived from

for improvement. It is mainly necessary to study the larger worker groupings such as the custodians since it would be unwise not to concentrate at the present time on a study of this part of the University's maintenance program. Considerable fear and suspicion on the part of the maintenance employees is necessarily also. This fear should be eliminated by a thorough explanation of what the program is trying to accomplish and how the tests and evaluations will be used. It should also be emphasized that this would not be a program to single out a particular worker nor drastically affect the workforce. Rather, the program would serve to increase the quality of performance and increase the amount of administrative staff contact with the maintenance program and those who run it in the University. Along with the industrial engineering techniques, the improvements previously mentioned such as employee training and scheduling must be used concurrently to achieve maximum benefits.

Comparison with Other Maintenance Operations

This paper has covered various possibilities to improve the University's maintenance program [illegible] which have proved successful in [illegible]

[illegible]

papers and correspondence with prominent directors of various university physical plants. A question arises, however, as to how this University compares with others around the country in the operation of its Buildings and Grounds Department. In some aspects the operation of a university is not comparable to an industrial operation; therefore, a comparison of like entities is in order.

To accomplish this comparison, a questionnaire, a copy of which may be found in Appendix II, page 165, was sent to a number of North American colleges and universities. The results of this questionnaire plus some adaptations of a similar survey by Mr. Sam F. Brewster are found in the following tables.

The first problem was how to group the replies. The questionnaire pointed up the fact that there are small schools with large physical plants, such as those schools with agricultural departments; and there are also large schools with small physical plants. This lack of continuity forced a closer examination of the grouping to be used to summarize the questionnaire. Since Buildings and Grounds Departments service facilities utilized by students, the replies were finally grouped into four divisions according to student enrollment. Further examination of the groupings,

parent and correspondence with prominent directors of various university physical plants. A question arises, however, as to how this University compares with others around the country in the operation of its buildings and grounds departments. In some aspects the operation of a university is not comparable to an industrial operation; therefore, a comparison of like entities is in order.

To accomplish this comparison, a questionnaire, a copy of which may be found in Appendix II, page 185, was sent to a number of North American colleges and universities. The results of this questionnaire plus some observations of a similar survey by Mr. [illegible] F. [illegible] are shown in the following tables.

The first problem was how to group the replies. The questionnaire pointed up the fact that there are small schools with large physical plants, such as those schools with agricultural departments; and there are also large schools with small physical plants. This fact in particular forced a closer examination of the grouping to be used in presenting the questionnaire. Since buildings and grounds departments service facilities utilized by students, the replies were finally grouped into four categories according to [illegible]

thus defined, showed that the number of square feet of academic floor area per student was consistent within the groupings. There were a few institutions within the individual groupings which did not conform. However, the number of schools which exceeded this average for each grouping was balanced by an equivalent number of schools below the average. Therefore, grouping the institutions by student enrollment tended to give a realistic comparison. Also, only a few schools within the enrollment groupings varied from the median physical plant size. The exceptions to this were the specialized schools, such as medical and dental schools, which simply do not fit into the pattern of physical plants of colleges and universities. Therefore, while these schools are shown in Group IV on Table 5, they were omitted from the summations of data found in the remainder of the tables. The institutional grouping for the purpose of the tabulation of the questionnaire is found in this Table 5.

The summary of the composition and service responsibility of the average Buildings and Grounds Department, Tables 6 through 8, shows some interesting comparisons. The University of New Mexico is a part of Group II. Table 6 shows that the

than [illegible], however, that one instance of [illegible]

[illegible] the [illegible]

groups [illegible]. [illegible]

individual [illegible]

[illegible]

[illegible] was [illegible]

below the [illegible]

by [illegible]

Also, [illegible] a few [illegible]

[illegible] the [illegible]

in this [illegible]

dental [illegible]

physical [illegible]

which [illegible]

were [illegible] and [illegible]

[illegible]. The [illegible]

the [illegible]

in [illegible].

The [illegible]

of the [illegible]

through [illegible]

of [illegible]

TABLE 5

INSTITUTIONAL GROUPING FOR THE PURPOSE
OF QUESTIONNAIRE TABULATION

	Institutions	Fall Term 1959 Enrollment
No.	Group I (Institutions with Enrollment 12,000 and up)	
1	Brooklyn College	24,364
2	California, University of Southern	13,500
3	California, University of (Berkeley)	19,344
4	California, University of (Los Angeles)	16,488
5	Cincinnati, University of	16,338
6	Indiana University	15,112
7	Michigan State University	19,146
8	Michigan, University of	23,506
9	Minnesota, University of	21,777
10	Ohio State University	24,000
11	Pennsylvania State University	14,000
12	Pittsburgh, University of	15,583
13	Purdue University	13,368
14	Texas, University of	17,759
No.	Group II (Institutions with Enrollments 6,000-12,000)	
1	Alabama,Polytechnic Institute	8,542
2	Arizona, University of	10,711
3	Brigham Young University	9,764
4	British Columbia, University of	9,950
5	Buffalo, University of	9,101
6	Cornell University	10,537
7	Harvard University	11,151
8	Hofstra College	7,984
9	Illinois University, Southern	7,469
10	Iowa, State University of	10,516
11	Kansas State College	6,706
12	Kansas, University of	8,538
13	Kentucky, University of	7,646
14	Louisville, University of	7,077
15	Marquette University	10,822
16	Maryland, University of	11,105
17	Massachusetts Institute of Technology	6,200
18	Missouri, University of	10,261

19	Nebraska, University of	7,802
20	New Mexico, University of	6,914
21	Oklahoma State University	8,836
22	Oklahoma, University of	10,465
23	Oregon State College	7,960
24	Oregon, University of	6,192
25	Saint Louis University	7,002
26	Stanford University	8,420
27	Texas, Agricultural and Mechanical College of	6,952
28	Texas,Technological College	8,770
29	Utah, University of	8,709
30	Yale University	8,500

No.	Group III (Institutions with Enrollment 1,500-6,000)	
1	Arkansas, University of	5,783
2	Brown University and Pembroke College	3,761
3	California, University of, Davis Campus	2,396
4	Chicago, University of	5,804
5	Colorado State College	3,759
6	Colorado State University	5,593
7	Dartmouth College	3,100
8	Delaware, University of	2,659
9	Denver, University of	5,500
10	DePauw University	2,141
11	Kansas State Teachers College	3,086
12	Massachusetts, University of	5,271
13	Missouri State College, Southeast	2,123
14	Montana State College	3,843
15	Morgan State College	2,373
16	New Hampshire, University of	1,947
17	New Mexico State University	2,644
18	North Carolina State College	5,682
19	North Carolina, University of, Women's College	2,230
20	Ontario, University of, Western	2,680
21	Puget Sound, College of	2,246
22	Radcliff College	1,580
23	Rhode Island, University of	2,675
24	Rochester, University of	2,389
25	Saskatchewan, University of	3,600
26	Smith College	2,094
27	South Dakota State College	3,824

28	South Dakota, State University of	2,353
29	Southern Methodist University	5,942
30	Southern University and A. & M. College	4,650
31	Trinity University	1,800
32	Tulane University of Louisiana	4,363
33	Tuskegee Institute	2,004
34	Utah State University	4,786
35	Vermont, University of and State Agricultural College	3,276
36	Washburn University of Topeka	1,500
37	Wellesley College	1,681
38	Wichita, University of	5,700
39	Wyoming, University of	3,613

No.	Group IV (Institutions with Enrollment up to 1,500)	
1	Anderson College	920
2	Babson Institute	670
3	Baylor University College of Medicine*	321
4	California Institute of Technology	1,258
5	California, University of (Riverside)	1,006
6	Colorado College	1,222
7	Earlham College	841
8	Goucher College	760
9	Graceland College	708
10	Grinnell College	925
11	Hesston College	252
12	Indiana University Medical Center*	1,400
13	Midland College	492
14	Nebraska, University of, College of Medicine*	452
15	New Mexico Highlands University	901
16	Oklahoma Baptist University	1,200
17	Oregon, University of, Medical and Dental School*	947
18	St. Lawrence University	1,302
19	Springfield College	1,493
20	Texas, University of, Dental Branch*	500
21	Texas, University of, Medical Branch*	786
22	Thiel College	750
23	Union College	1,017
24	Williams College	1,145
25	William Jewell College	836
26	Worcester Polytechnic Institute	1,135

*Note: These institutions are not included in the tabulations in Tables 6 through 20.

8	South Dakota, State University of	[illegible]
9	Southern Methodist University	1,34[illegible]
10	Southern University and A. & M. College	[illegible]
11	Trinity University	1,810
12	Tulane University of Louisiana	[illegible]
13	Tuskegee Institute	2,[illegible]
14	Utah State University	1,[illegible]
15	Vermont, University of and State Agricultural College	[illegible]
16	Washburn University of Topeka	1,5[illegible]
17	Wellesley College	[illegible]
18	Wichita, University of	[illegible]
19	Wyoming, University of	[illegible]

No.	Group IV (Institutions with enrollments up to [illegible])	
1	Anderson College	[illegible]
2	Babson Institute	[illegible]
3	Baylor University College of Dentistry*	[illegible]
4	California Institute of Technology	[illegible]
5	California, University of (Riverside)	[illegible]
6	Colorado College	[illegible]
7	Earlham College	[illegible]
8	Goucher College	[illegible]
9	Graceland College	[illegible]
10	Grinnell College	[illegible]
11	Hendrix College	[illegible]
12	Indiana University Medical Center*	[illegible]
13	Midland College	[illegible]
14	Nebraska, University of, College of Medicine*	[illegible]
15	New Mexico Highlands University	[illegible]
16	Oklahoma Baptist University	1,[illegible]
17	Oregon, University of, Medical and Dental Schools*	[illegible]
18	St. Lawrence University	[illegible]
19	Springfield College	[illegible]
20	Texas, University of, Dental Branch*	[illegible]
21	Texas, University of, Medical Branch*	[illegible]
22	[illegible] College	[illegible]
23	Union College	[illegible]
24	Williams College	[illegible]
25	William Jewell College	[illegible]
26	Worcester Polytechnic Institute	1,[illegible]

* [illegible]

number of maintenance employees is a function of the student enrollment although the number of employees increases at a lesser rate than does the student enrollment. Since there is a minimum number of key personnel necessary in even a small organization, as enrollments increase, maintenance personnel get busier, but it is not necessary to hire additions to the staff in proportion to the enrollment increases. Large schools should operate more efficiently on a per student basis if such be the case. Likewise as the school grows in size, the percentage of the budget allotted to Buildings and Grounds is also lessened.

This reduction in the percentage of the budget allotted to the Buildings and Grounds Department does not increase to any extent until the student enrollment of the institution is sufficient to raise it to the next higher enrollment grouping as shown in Table 5. This was brought to light by examination of the individual questionnaires in each grouping. For example, the University of New Mexico would have to increase its enrollment to over 12,000 students for such a decrease to take place in the percentage of the budget retained by Buildings and Grounds. However, as shown by Table 6, when the increased enrollment of the University moved the school from Group III to Group II, a corresponding reduction in the

a lot of [illegible] in [illegible] [illegible] [illegible] in a [illegible] number of [illegible] in [illegible] [illegible] to the [illegible] [illegible]

This [illegible] of the [illegible] [illegible] as [illegible] of the [illegible] [illegible]

TABLE 6

SUMMARY OF THE COMPOSITION OF AN AVERAGE BUILDINGS AND GROUNDS DEPARTMENT

	Group I	Group II	UNM	Group III	Group IV
Supervisor's Title	Director of Phys. Plant	Director of Phys. Plant	Director of Phys. Plant	Superintendent-B & G	Director of Phys. Plant
Supervisor Reports to	Business Manager	Business Manager	Comptroller	Business Manager	Business Manager
Number of Workers	407	286	140	131	64
Unionization of Workers	Partly	None	None	None	None
Working Days Per Week	5	5	5	5	5 1/2
Working Hours Per Week	40	40	40	40	45
Job Instruction Form	Written	Written	Written and Oral	Written and/or oral	Written and oral
Percent of Educational Budget allotted to Buildings and Grounds	9	10	15	13.7	14.4
Minimum percent of Educational Budget Desired by Buildings and Grounds	11	12	20	15.4	Satisfied
Percent of Buildings and Grounds Budget Committed at Time of Receipt	--	73.6	95	81.6	80.0
Motor Pool	Yes	No	Yes	No	No
Pieces of Automotive Equipment	28	30	50	14	6
Pieces of Heavy Equipment (e.g. Construction Equipment	10	9	12	5.5	2.5
Shop Facilities	Good	Good	Good	Good	Poor

[a]Adapted from: Questionnaire and Sam F. Brewster, Organizations and Functions of Physical Plant Departments of Universities and Colleges.

TABLE 7

FACILITIES SERVICED BY AVERAGE BUILDINGS AND GROUNDS DEPARTMENTS[a]

	Group I	Group II	UNM	Group III	Group IV
Student Enrollment	18,000	8,686	7,800	3,485	894
Campus Area-Acres	1,132	1,000	400	556	261
Campus Area Intensively Maintained-Acres	387	288	100	224	75
Number of Buildings	192	175	86	97	44
Floor Area of Buildings-Square Feet	4,827,000	2,769,000	1,595,600	1,331,785	517,738
Temporary Building Area-Square Feet	321,000	240,000	40,000	108,000	26,000

[a]Adapted from: Questionnaire and Sam F. Brewster, Organizations and Functions of Physical Plant Departments of Universities and Colleges, Kansas State University, Manhattan, Kansas, May 11, 1959.

TABLE 8

SPACE ALLOCATION OF CAMPUS BUILDINGS[a]

(Values in Square Feet)

	Group I	Group II	UNM	Group III	Group IV
Primarily Academic	2,696,468	1,315,285	864,800	609,814	227,256
Dormitories (Men & Women)	921,763	719,486	300,700	361,304	149,373
Football Stadium	266,303	82,812	127,000	49,580	12,260
All Food Facilities	170,239	68,095	N/A	42,508	17,917
Physical Plant Facilities	102,546	64,110	42,000	39,852	20,311
All Other Campus Buildings	605,634	487,730	430,100	208,682	121,523
Area Per Student-All Campus Buildings	261	325	205	413	570
Area Per Student-Academic Buildings Only	146	165	111	191	251

[a]Adapted from: Questionnaire and Sam F. Brewster, Organizations and Functions of Physical Plant Departments of Universities and Colleges, Kansas State University, Manhattan, Kansas, May 11, 1959.

percentage of the total University budget retained by the Buildings and Grounds Department did not take place. This indicates that the Buildings and Grounds Department has a larger budget, percentage-wise, than other institutions of comparable enrollment. This is again reiterated by noting, in Table 8, that the University has a relatively low area per student. Therefore, all indications are that the University of New Mexico allots a greater percentage of its total budget to the Buildings and Grounds Department than do other schools of comparable enrollments.

It is likely the Buildings and Grounds Department could free some of its funds for other uses by closer maintenance control procedures. Such a reduction in the maintenance budget of the University would bring the ratio of maintenance allocations to total University expenditures more in proportion to the ratio of maintenance allocations to total budgets of other institutions of comparable enrollments.

In all fairness to the University, one should go one step beyond the tables and note that the University handles more area per maintenance employee than the average for every group except those schools with an enrollment of greater than 12,000 students.

Another factor should also be noted. The University of

percentage of the total University budget retained by the Buildings and Grounds Department will not take place. This indicates that the Buildings and Grounds Department has a larger budget, percentage-wise, than other institutions of comparable enrollment. This is again reiterated by noting, in Table 8, that the University has a relatively low area per student. Therefore, all indications are that the University of New Mexico allots a greater percentage of its total budget to the Buildings and Grounds Department than do other schools of comparable enrollments.

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In all fairness to the University, one should go one step beyond the tables and note that the University handles more area per maintenance employee than the average for other group members, since schools with an enrollment of greater than 15,000 students.

[illegible]

New Mexico has been expanding its physical plant quite rapidly to keep pace with increased enrollments, and much of the maintenance budget goes towards this expansion of facilities. However, it should be kept in mind that most of the other institutions have undergone similar expansions and still have found it possible to reduce the percentage of their total budgets spent on the maintenance of their physical plants, as shown in the reports obtained by the questionnaire.

The tables also show that as the size of the maintenance department decreases, the organization becomes more informal, and probably less effective, in part due to the multi-skill nature of the employees. With an informal organization, many times scheduling is done in such a loose way that much time is lost while an employee "floats" from job to job. Table 6 points out that very few of the schools have any unionization of their Buildings and Grounds Departments. Lack of unionization often aids a maintenance department through removing jurisdictional problems. This table also shows a universal desire of all departments, the desire for a larger share of the total budget. This desire is exhibited by the University's Buildings and Grounds Department also.

Another sidelight pointed up by this tabulation is the better than average utilization of space by the University.

New Mexico has been expanding its physical plant rather rapidly to keep pace with increased enrollments, and much of the maintenance budget goes towards this expansion of facilities. However, it should be kept in mind that most of the other institutions have undergone a similar expansion and still have found it possible to reduce the percentage of their total budgets spent on the maintenance of their physical plants, as shown in the reports obtained by the questionnaire.

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Another highlight pointed up by this evaluation is the better than average utilization of space by the University.

With the prospect of rapidly expanding enrollments facing colleges and universities in the near future, building areas must be used more intensively. This also means a need for more intensive maintenance.

In the majority of schools reporting, all campus maintenance is handled by the Buildings and Grounds Departments (Table 9). While some schools do have custodial tasks and minor repairs done by their Housing Divisions or Student Union Staff, this division of responsibility could lead to operating inefficiencies such as dual supplies of maintenance equipment. Proper maintenance control and employee training can also be handled more simply through one organization. The Buildings and Grounds Department of the University is a centralized organization with responsibility over the entire campus; therefore, any program of maintenance control could be immediately focused upon the desired areas and carried out more effectively than would be the case if maintenance responsibility were diversified.

As previously noted, the number of maintenance personnel varies with student enrollment. Table 10 shows that the main job classification affected is, however, the custodial worker. Janitors are the largest single segment of the physical plant complex and thus affect the operation greatly. The other job

which are obsolete or rapidly approaching obsolescence facing colleges and universities in the near future, building sites must be used more intensively. This will demand greater and more efficient maintenance.

In the majority of schools reporting, all campus maintenance is handled by the Buildings and Grounds Departments (Table 9). While some schools do have custodial tasks and minor repairs done by their housing director or student union board, this division of responsibility shall lead to overlapping jurisdictions, such as time, supplies, maintenance equipment. Proper maintenance control and uniform standards can also be handled more simply through one single office. The Buildings and Grounds Department of the [illegible] plays [illegible] centralized organization with responsibility [illegible] entire physical plant, any program of maintenance control should be immediately centered upon the central plant and carried out more effectively than would be the case if maintenance responsibility were decentralized.

As previously stated, the success of maintenance personnel work [illegible] the best conditions. [illegible]

[illegible]

[illegible]

[illegible]

TABLE 9

MAINTENANCE AND OPERATIONS WORK DONE BY DEPARTMENTS OTHER THAN BUILDINGS AND GROUNDS.[a] (In all cases work done was of a custodial nature or minor repairs)

	Group I	Group II	UNM	Group III	Group IV
Number of Schools Reporting	14	30	--	39	26
% of Schools with Departments other than Buildings and Grounds doing Maintenance and Operations Work.	35.7	48.3	None	39.8	26.9
Departments Doing This Work	Hospital Union	Housing Union	--	Housing Union	Union

[a]Adapted from: Questionnaire and Sam F. Brewster, <u>Organizations and Functions of Physical Plant Departments of Universities and Colleges</u>, Kansas State University, Manhattan, Kansas, May 11, 1959.

TABLE 10

AVERAGE NUMBER OF EMPLOYEES IN VARIOUS JOB CATEGORIES AMONG REPRESENTATIVE BUILDINGS AND GROUNDS DEPARTMENTS[a]

Job Category	Group I				Group II				University of New Mexico				Group III				Group IV			
	Full Time		Part Time		Full Time		Part Time		Full Time		Part Time		Full Time		Part Time		Full Time		Part Time	
	Student	Other	Student	Other	Student	Other	Student	Other	Student	Other	Student	Other	Student	Other	Student	Other	Student	Other	Student	Other
Custodial	5	145	22	3	--	83	67	8	5	36	--	--	4	49	32	7	2	21	7	6
Refuse Disposal	--	5	--	--	--	3	2	1	--	2	--	--	--	3	2	2	--	2	1	2
Landscape Maintenance	--	18	5	28	--	18	8	9	2	7	--	--	2	10	6	8	--	6	4	3
Pest Control	--	1	1	3	--	2	--	1	--	--	--	--	--	2	2	1	--	1	--	1
Campus Mail	--	--	--	1	--	3	6	4	--	1	--	--	--	2	7	1	--	1	4	1
General Trucking	--	12	4	--	--	6	5	2	--	3	--	--	--	3	2	1	--	2	2	1
Mechanical Repairs	--	16	3	2	--	5	4	5	--	4	--	--	--	3	2	2	--	3	2	5
Air Conditioning & Ventilation	--	10	--	6	1	4	2	2	--	4	--	--	--	3	--	1	--	6	3	3
Refrigeration	--	8	--	2	--	2	--	1	--	1	--	--	--	2	--	--	--	2	--	3
Sheet Metal	--	9	--	1	--	4	2	1	--	1	--	--	1	2	1	--	--	2	--	2
Heating	--	17	--	2	--	12	3	3	--	3	--	--	--	6	3	--	--	4	--	2
Plumbing	--	14	--	2	--	8	3	3	--	4	--	--	2	5	2	1	--	3	2	2
Automotive Repair	--	5	--	2	--	2	--	1	--	4	--	--	--	2	2	--	--	1	1	1
Motor Pool	--	5	--	1	--	3	4	1	--		--	--	--	2	--	2	--	1	--	2
Locksmith Work	--	2	--	1	--	1	1	1	--	1	--	--	--	1	1	1	--	1	--	1
Keys	--	1	--	1	--	1	1	1	--		--	--	--	1	1	1	--	1	--	1
Campus Police	--	18	1	--	2	9	5	1	--	8	--	--	3	4	6	18 (4)	--	2	3	1
Night Watchman	--	9	1	--	--	9	2	2	--		--	--	3	6	5	3	1	2	2	1
Fire Prevention & Control	--	2	--	2	2	3	4	1	--	--	---	--	--	2	5	1	--	1	1	1
Room Scheduling	--	2	--	--	--	1	2	--	--	--	--	--	--	1	--	--	--	--	--	--
Electrical	--	19	5	6	--	9	3	8	3	6	--	--	4	5	2	1	--	4	2	2
Campus Phones	--	12	--	4	3	5	9	2	--	--	--	--	--	3	7	1	--	3	7	1
Office Machine Repair	--	5	--	--	--	1	2	--	--	--	--	--	--	1	--	--	--	--	--	1
Painting	--	17	3	--	--	12	2	16	--	4	--	--	--	6	6	7	--	3	5	3
Carpentry	--	17	3	5	--	13	4	14	1	5	--	--	1	8	2	2	--	3	1	2
Cabinet Work	--	9	--	2	1	3	--	2	--	2	--	--	--	2	2	1	--	2	--	2
Furniture Repair	--	4	--	1	--	1	--	2	--	2	--	--	--	2	1	1	--	2	1	1
Upholstery	--	2	--	--	--	2	--	--	--	--	--	--	--	2	--	2	--	--	--	1
Laundry	--	1	--	--	--	74 (2)	--	--	--	--	--	--	--	25 (4)	4	1	--	5	--	2
General Stores	--	3	--	--	--	5	4	2	1	5	--	--	1	2	1	--	--	2	1	1
All Others	--	47	5	2	4	29	11	10	--	25	--	--	1	14	3	11	--	10	2	4

Notes: Part Time Figures based upon a work week of 20 hours.

Figures in parentheses represent the number of schools reporting.

[a]Adapted from: Questionnaire and Sam F. Brewster, Organizations and Functions of Physical Plant Departments of Universities and Colleges, Kansas State University, Manhattan, Kansas, May 11, 1959.

categories remain relatively constant as far as the worker to student ratio is concerned. This again tends to reveal some of the inherent operating inefficiencies in the smaller schools.

In this day of rising educational costs, it is well to note the effort made by many departments to utilize student labor. This employment is quite helpful to the students' financial condition. By and large, a student, even when on a part-time basis, performs a higher caliber of work. The employees that the Buildings and Grounds Department could hire temporarily for peak load tasks often have little interest in their work and do not try to provide a high enough level of performance. There are several reasons for the general superiority of student labor over other temporary labor. First, the student usually is more intelligent than the average part-time laborer. Second, if he is willing to work his way through the University, the student has more ambition than a temporary laborer. And finally the students have more pride in the quality of work they perform.[37] This does not mean that every student will prove to be a superior worker, but in general, this will be the case in semi-skilled tasks. Unfortunately the University has done little to

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[37]Interview with Glenn Miner, General Services Corporation, October, 1960.

utilize student labor, and it could very well try to improve its record in this area. Admittedly, students are often not skilled in many tasks; however, for many of the peak or seasonal demands, semi-skilled help is sufficient.

Table 11 indicates that the University's rate of wages paid to supervisory employees is quite comparable with rates in schools of similar enrollment. While the employees in a supervisory capacity are receiving average compensation for their labor, the workers being paid on an hourly basis are not as fortunate. Their wage rates are below the average wage rate for a given job classification of all other institutions reporting. The University's hourly wage rates are also below the prevailing wage in the Albuquerque area (Table 12). There is no fringe benefit package to compensate for this differential either. As previously mentioned, the average competence of the skilled maintenance worker at the University is high. Therefore, the present management of the Buildings and Grounds Department must be highly complimented for creating an atmosphere which has resulted in the low skilled labor turnover despite the existing wage differential, especially between the University and Sandia Corporation.[38]

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[38] For a comparison, see Wage and Salary Administration Department, Albuquerque Area Wage Survey, 1961 (Sandia Corporation: Albuquerque, 1961).

TABLE 11

AVERAGE ANNUAL WAGE PAID TO SUPERVISORY PERSONNEL BY REPRESENTATIVE BUILDINGS AND GROUNDS DEPARTMENTS[a] (Figures in Dollars)

	Group I	Group II	UNM Survey Mean	Group III	Group IV
Chief Physical Plant Administrator	12,636	10,800	11,000	8,438	7,954
Ass't Administrator	9,367	7,814	9,000	7,368	5,833
Principal Planner	9,657	6,763	5,700	6,650	9,900*
Principal Construction Engineer	8,000	6,817	6,300	6,160	10,100*
Chief Air Conditioning Engineer	7,225	5,950	5,700	5,886	7,633*
Chief Heating Plant Engineer	8,127	6,714	5,100	5,700	5,815
Chief Security Officer	6,511	5,140	5,100	4,445	4,050
Chief Auto Mechanic	5,638	5,000	5,100	4,714	4,800*
Locksmith	5,188	4,835	4,500	4,140	4,800
Electrical Foreman	6,550	6,117	6,300	5,173	5,778
Mechanical Foreman	6,855	6,087	5,700	5,243	5,573
Carpenter Foreman	6,600	5,730	5,700	4,820	5,062
Custodial Foreman	5,775	5,130	5,100	4,631	4,200
Landscape Foreman	6,092	5,333	---	4,586	4,454
Paint Foreman	6,436	5,470	4,500	4,878	4,777
Labor Foreman	5,978	4,985	4,500	4,550	4,500

*Only three schools reporting.

[a]Adapted from: Questionnaire and Sam F. Brewster, Organizations and Functions of Physical Plant Departments of Universities and Colleges

TABLE 12

AVERAGE HOURLY WAGE RATES PAID TO EMPLOYEES BY REPRESENTATIVE BUILDINGS AND GROUNDS DEPARTMENTS, INCLUDING A COMPARISON OF THE AVERAGE ALBUQUERQUE AREA WAGE
(Figures in Dollars)

	Group I	Group II	UNM	Alb. Area	Group III	Group IV
Skilled Carpenters	2.83	2.34	1.75	2.52	2.16	2.30
Skilled Electricians	2.96	2.26	2.00	2.80	2.27	2.10
Skilled Plumbers	3.00	2.41	2.00	2.78	2.20	2.20
Skilled Painters	2.48	2.17	1.50	2.68	2.08	2.03
Skilled Gardeners	1.93	1.78	1.25	1.59	1.66	1.68
Skilled Labor	2.20	1.71	1.25	1.92	1.56	1.70
Full Time Common Labor	1.71	1.59	1.25	1.60	1.34	1.29
Part Time Common Labor	1.40	1.15	1.25	----	1.11	0.94
Student Help	1.40	1.15	1.25	----	1.11	0.94

[a]Adapted from: Questionnaire and Sam F. Brewster, Organizations and Functions of Physical Plant Departments of Universities and Colleges, Kansas State University, Manhattan, Kansas, May 11, 1959.

Some qualification of this statement is in order. The University does not have such strict medical requirements as many employers in the Albuquerque area, and particularly Sandia Corporation.[39] This, combined with a lower personal standard than that used by some Albuquerque area employers, results in the lack of alternate employment opportunities for many of the University's unskilled workers such as the custodians.[40] However, most of the employees in the skilled trades such as electrical and mechanical maintenance remain with the University through personal choice. They prefer to work for the University's Buildings and Grounds Department rather than for another employer, even though there is a wage differential. There is a compensating factor, however, that tends to equalize the lower wage rate paid by the University and union scale. The University's maintenance workers are employed the entire year with no lay-off due to bad weather, a lack of contracts, or between job lay-overs. Therefore, while a union carpenter will make more per hour, many of them will not do as well on a yearly basis. This factor should always be kept in mind when comparing hourly wage rates.

Campus planning is becoming an important and critical

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[39]From information obtained through interviews with John A. Jacobson (May, 1961) and J. C. Hart (June, 1961).

[40]Interview with John A. Jacobson, May, 1961.

[illegible]

[illegible]

task for most universities and colleges. This is shown in Table 13. A discontinuity arises in this table in Group IV. These institutions have an average of eight people in their planning departments; yet they seem to have the fewest long-range plans. The University is to be commended for its effort in the field of advanced planning, and it is in a better position in this respect than most of the universities replying to the questionnaire.

The remainder of the data in the comparative analysis, Tables 14 through 19 was obtained as a supplement to the information on over-all campus planning. This is a comparison of the assignment of responsibility for campus expansion and improvement. These tables point up that few of the schools reporting feel that they are economically justified in retaining sufficient technically qualified personnel to do the entire job of campus construction design within their Buildings and Grounds Departments. The majority of schools will retain architectural and engineering firms for these tasks. Fortunately, since the buildings are the physical plant department's responsibility after construction, the department is allowed to interject its experience with facility maintenance into plans for new construction.

cost are most unpopular in Michigan. This is shown in Table 13. A [illegible] large [illegible] seem to have [illegible] in their planning department, and many [illegible] to have the [illegible] long-range plans. The University [illegible] one effort in the field of [illegible] planning, and is in a better position in this respect than most of the universities replying to the questionnaire.

The remainder of the data in the [illegible] study, Tables 14 through 19 [illegible] assignment to the information on overall campus planning. This is a [illegible] of the assignment of [illegible] for campus expansion and improvement. These tables show [illegible] reporting [illegible] that they [illegible] including architects [illegible] the entire job of campus [illegible] buildings and grounds department. [illegible] will consult or [illegible] basis. Fortunately, [illegible] planning department's responsibility [illegible]

TABLE 13

PLANNING AND CONSTRUCTION INFORMATION[a]
(Values in percent of schools reporting)

	Group I		Group II		UNM		Group III		Group IV	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Some Form of Campus Planning Committee	85.7	14.3	93.3	6.7	X		87.2	7.7	69.2	17.0
Planning Section in Building and Grounds Department	85.7	14.3	50.0	50.0	X		30.8	64.1	11.5	88.5
Campus Master Plan: Is one in existence?	100.0	0	83.3	16.7	X		82.1	12.8	46.2	46.2
Is it followed closely for location of buildings and facilities?	85.7	14.3	63.3	36.7	X		74.4	20.5	46.2	46.2
Is it adequate in the foreseeable future?	85.7	14.3	63.3	36.7	X		56.4	38.5	46.2	46.2
Average Number of People Employed as Planners	6		4		2		2		8	

[a]Adapted from: Questionnaire and Sam F. Brewster, Organizations and Functions of Physical Plant Departments of Universities and Colleges, Kansas State University, Manhattan, Kansas, May 11, 1959.

TABLE 14

GROUP RESPONSIBLE FOR PREPARATION OF PLANS AND SPECIFICATIONS OF NEW MAJOR BUILDINGS AS REPORTED BY REPRESENTATIVE BUILDINGS AND GROUNDS DEPARTMENTS[a]
(Values expressed as percent of universities reporting)

Responsible Group	Group Number				
	I	II	UNM	III	IV
Buildings and Grounds Department	---	---	---	---	7.8
Contract Architects and/or Engineers	78.6	50.0	X	79.5	65.4
Buildings and Grounds Departments with Contract Architects and/or Engineers	14.2	33.3	---	7.7	7.7
Miscellaneous University Personnel	---	3.3	---	2.6	19.1
State Architect	---	10.0	---	5.1	---

[a]Adapted from: Questionnaire and Sam F. Brewster, _Organizations and Functions of Physical Plant Departments of Universities and Colleges_, Kansas State University, Manhattan, Kansas, May 11, 1959.

TABLE 15

GROUP RESPONSIBLE FOR PLANNING DETAILS AND PROGRAMMING REQUIREMENTS OF NEW MAJOR BUILDINGS AS REPORTED BY REPRESENTATIVE BUILDINGS AND GROUNDS DEPARTMENTS.[a]
(Values expressed as percent of universities reporting)

Responsible Group	Group Number				
	I	II	UNM	III	IV
Buildings and Grounds Department	---	20.0	---	---	7.7
Contract Architects and/or Engineers	28.4	---	---	7.7	---
Buildings and Grounds Department with Contract Architects and/or Engineers	7.1	20.0	X	---	---
Buildings and Grounds Departments with University Personnel	14.2	20.2	X	7.7	26.9
Campus Planning Committee	28.4	26.6	---	12.8	30.8
University Administration	14.2	13.3	---	30.8	26.9
Miscellaneous University Personnel	---	---	---	28.2	3.8
State Architect	---	---	---	5.1	---

[a]Adapted from: Questionnaire and Sam F. Brewster, Organizations and Functions of Physical Plant Departments of Universities and Colleges, Kansas State University, Manhattan, Kansas, May 11, 1959.

TABLE 16

GROUP RESPONSIBLE FOR DETAILED INSPECTIONS ON MAJOR CONSTRUCTION PROJECTS AS REPORTED BY REPRESENTATIVE BUILDINGS AND GROUNDS DEPARTMENTS[a]

(Values expressed as percent of universities reporting)

Responsible Group	Group Number				
	I	II	UNM	III	IV
Buildings and Grounds Department	35.7	43.3	X	15.4	23.0
Contract Architects and/or Engineers	42.9	20.0	---	23.1	26.9
University Architects and/or Engineers	21.4	20.0	---	25.6	26.9
State Architects	---	10.0	---	15.4	---

[a]Adapted from: Questionnaire and Sam F. Brewster, Organizations and Functions of Physical Plant Departments of Universities and Colleges, Kansas State University, Manhattan, Kansas, May 11, 1959.

TABLE 17

GROUP RESPONSIBLE FOR PLANS FOR REMODELING EXISTING BUILDINGS AS REPORTED BY REPRESENTATIVE BUILDINGS AND GROUNDS DEPARTMENTS.[a] (Values expressed as percent of universities reporting)

Responsible Group	Group Number				
	I	II	UNM	III	IV
Buildings and Grounds Departments	7.2	46.7	X	33.3	3.8
Contract Architects and/or Engineers	7.2	13.3	---	---	3.8
Buildings and Grounds Departments with Contract Architects and/or Engineers	71.5	13.3	---	23.1	34.6
Buildings and Grounds Departments with University Personnel	---	3.3	---	5.1	19.2
Campus Planning Committee	---	6.6	---	2.6	---
Miscellaneous University Personnel	7.2	6.7	---	23.1	30.7
State Architect	---	10.0	---	5.1	---

[a]Adapted from: Questionnaire and Sam F. Brewster, _Organizations and Functions of Physical Plant Departments of Universities and Colleges_, Kansas State University, Manhattan, Kansas, May 11, 1959.

TABLE 18

GROUP RESPONSIBLE FOR PREPARATION OF PLANS AND SPECIFICATIONS FOR EXTENSIONS TO OUTSIDE UTILITIES AS REPORTED BY REPRESENTATIVE BUILDINGS AND GROUNDS DEPARTMENTS[a]
(Values expressed as percent of universities reporting)

Responsible Group	Group Number				
	I	II	UNM	III	IV
Buildings and Grounds Departments	21.4	36.7	X	20.5	34.6
Consulting Architects and/or Engineers	50.0	20.0	---	23.1	30.8
Buildings and Grounds Departments with Contract Architects and/or Engineers	28.6	36.6	---	43.6	15.4
Miscellaneous University Personnel	---	3.3	---	2.6	3.8
State Architect	---	3.3	---	5.1	---

[a]Adapted from: Questionnaire and Sam F. Brewster, Organizations and Functions of Physical Plant Departments of Universities and Colleges, Kansas State University, Manhattan, Kansas, May 11, 1959.

TABLE 19

GROUP RESPONSIBLE FOR LANDSCAPING PLANS AS REPORTED BY REPRESENTATIVE BUILDINGS AND GROUNDS DEPARTMENTS.[a] (Values expressed as percent of universities reporting)

Responsible Group	Group Number				
	I	II	UNM	III	IV
Buildings and Grounds Department	7.1	23.3	---	28.2	11.4
Contract Landscape Architects	57.2	23.4	---	38.5	38.5
Buildings and Grounds Department with Contract Landscape Architects	---	16.7	X	15.4	30.8
University Landscape Architecture Department	35.7	36.6	---	15.4	7.7

[a]Adapted from: Questionnaire and Sam F. Brewster, *Organizations and Functions of Physical Plant Departments of Universities and Colleges*, Kansas State University, Manhattan, Kansas, May 11, 1959.

It is necessary for the Buildings and Grounds Department to take part in new construction plans and then keep an accurate record of any modifications if the department is to do an adequate maintenance job. This is graphically illustrated by experiences at the University of New Mexico. Before World War II, the policy of the Superintendent of Buildings and Grounds was that, "if it wasn't written down, no one could blame you for it." This has resulted in bewildering failures in utility lines which no one even knew existed. Fortunately, the present Department keeps an accurate record of new construction and modifications to the existing system.

In summary, this chapter had a two-fold purpose. First, the present operation of the Buildings and Grounds Department was investigated to determine how closely the Department adhered to ideal concepts of operating a maintenance organization. Second, using the data obtained from the questionnaire, a set of comparative tables was constructed showing how the Buildings and Grounds Department at the University compared with other departments across the country.

The greatest present need is to establish a system of proper maintenance records and cost controls. The evaluation of such data would allow cost reductions through better

It is necessary for the building and grounds department to take part in new construction plans and to keep an accurate record of any modifications in the network [illegible] an adequate maintenance [illegible]. This [illegible] illustrated by experience at the University of New Mexico. Before World War II, the quality of the record [illegible] buildings and grounds was there, [illegible] no one could [illegible] considering failures in utility lines which [illegible] have existed. Fortunately, the present department keeps an accurate record of new construction and modifications to the existing system.

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[illegible]

[illegible]

[illegible]

utilization of men and equipment by comprehensive scheduling. Eighty percent of the work done by Buildings and Grounds should be carefully scheduled to provide efficient operation. Unforeseen emergencies will require the other twenty percent of the maintenance time. Cost controls obtained through cost accounting would enable the University to evaluate comprehensively its maintenance program and determine where savings might be made.

As previously mentioned, industrial engineering techniques along with a training program could be utilized to improve worker efficiency. These two additions should not only improve the quality of the worker's performance, but also result in a greater volume of work completed by each staff member.

In addition, the questionnaire tabulations revealed the fact that a maintenance staff normally does not increase in proportion with student enrollment. Also as student enrollments increase, the percentage of a total university budget allotted to maintaining the physical plant tends to decrease. The present percentage of the budget allotted to the University's Buildings and Grounds Department is fifteen percent which is higher than schools with similar enrollments. These institutions are only granted ten percent of the total budget. The tables also point out that all schools generally use their

Buildings and Grounds Department for new construction and renovation of old buildings to the same extent. These construction costs are also included in the allowance for the budgets.

Since the other buildings and grounds departments service their institutions on a smaller percentage of the total budget, it might be concluded that the University does not have as efficient a maintenance program as other institutions. This conclusion would not be valid, however, unless an extensive study were made of the quality and scope of the maintenance work at other schools. The maintenance staff at the University does compare well with the staffs at other institutions in regard to the size of staff per student and the gross floor area handled per employee.

Finally, taking the above factors into consideration, a twenty-five percent reduction in maintenance costs is not an unreasonable goal for which to strive. As mentioned previously, this reduction has been realized rather quickly in industry and likewise should be possible at the University. Such a reduction would free funds for use elsewhere in the University, or these funds could be used for new construction or renovation of existing facilities.

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CHAPTER III

SUBCONTRACTING MAINTENANCE FUNCTIONS

This paper has been devoted to an examination of the Buildings and Grounds Department at the University of New Mexico. The examination consisted of a comparison of the University's Buildings and Grounds Department with other departments across the country and also various methods to possibly improve the existing maintenance program. In this section of the paper, another possibility will be investigated. Would it be advantageous for the University to subcontract all or portions of its maintenance?

Effect of Subcontracting on the Various Maintenance Functions

If one were to ask one hundred supervisors whether or not it would be advantageous to subcontract maintenance work, one would, no doubt, receive one hundred different answers ranging in various degrees from yes to no. This, at least, has been the result shown by this study. The majority of people answering the questionnaire had preconceived notions resulting from either prejudice or limited experience with an individual instance. The United States Government had an experience which will serve to illustrate this point. When

subcontracting janitorial service was originally suggested by the Defense Department, a loud cry went up from Congressional committees that the government could not afford such a luxury. On further investigation, however, the average cost of the existing mediocre janitorial service at military installations on the East and Gulf Coasts of the United States and military hospitals throughout the country was found to be sixty cents per square foot per year. These installations, such as Fort Lee, Virginia and Wallops Island, Virginia, are now contracted at a price of twenty-four cents per square foot per year,[41] and the quality of custodial service also has improved.[42] To get the proper perspective of this problem, it will be necessary to examine the various maintenance functions and determine how subcontracting would relate to each of them.

First, before discussing the individual maintenance groupings, an over-all look at the basic advantages and disadvantages of subcontracting maintenance work is required.

> One of the big reasons for justification of a Physical Plant, regardless of whether it is efficient or otherwise, is that as all the mistakes made in existing buildings show up, a responsible department can take care of them. These mistakes and inefficiencies are brought to the attention of the planners designing new buildings, with the expressed desire that they not be repeated again.[43]

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[41]Note: This price includes the furnishing of such supplies as soap, paper towels, and toilet tissue by the contractor.

[42]Interview with Glenn Miner, October, 1960.

[43]Interview with John A. Jacobson, April, 1961.

subcontracting janitorial service was originally proposed by the Defense Department, a loud cry went up from Congressional committees that the government could not afford such a luxury. On further investigation, however, the average cost of the existing mediocre janitorial service at military installations on the East and Gulf Coasts of the United States and military hospitals throughout the country was found to be sixty cents per square foot per year. These installations, such as Fort Lee, Virginia and Wallops Island, Virginia, are now contracted at a price of twenty-four cents per square foot per year,[41] and the quality of custodial service also has improved.[42] To get the proper perspective of this problem, it will be necessary to examine the various maintenance functions and determine how subcontracting would relate to each of them.

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[illegible]

[41][illegible], 1968.

[42][illegible], 1968.

In other words, normally the lines of communication are better in an integrated organization than they are between contractors and their employers. This system of communication between maintenance men and the architect has provided some cost saving ideas. If one custodian were eliminated, $250,000 is saved over the fifty year life of a building.[44] Another factor is the familiarity gained by the entire Buildings and Grounds Department with the facilities through interchange of ideas within a single maintenance department. This continuity might well be lost if, through the necessity of competitive bidding, maintenance contracts went to a succession of companies.

Another difficulty arises in the writing of specifications. The places of work are often dispersed and temporary, and subject to frequent changes, often over a wide area. Much of the work is subjected to the unpredictability of the weather. These items coupled with the need for clear, informative well-drawn sets of plans coordinated with well-written and clear specifications present quite a problem. Specifications must also be free from ambiguity and clear in intent. (How far can one stretch intent?) To draw up such specifications, a careful survey would have to be made on each component part of the work. Inspection would also be a problem since the University

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[44] Ibid.

In other words, normally the lines of communication are better in an integrated organization than they are between contractors and their employers. This fostering of communication between maintenance men and the architect can produce some cost saving ideas. If one suggestion were implemented, $250,000 is saved over the fifty year life of a building. Another factor is the familiarity gained by the entire Buildings and Grounds Department with the facilities through interchange of ideas within a single maintenance department. This continuity might well be lost if, through the necessity of competitive bidding, maintenance contracts went to a succession of companies.

Another difficulty arises in the writing of specifications. The places of work are often dispersed and temporary, and subject to frequent changes, often over a wide area. Much of the work is subjected to the unpredictability of the weather. These items coupled with the need for clear, definitive well-drawn sets of plans coordinated with well-written and clear specifications present quite a problem. The specifications must also be free from ambiguity and clear in intent. (How can one stretch intent?) To draw up such specifications, a detailed survey would have to be made on each component part of the work. Inspection would also be a problem since the [illegible]

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44 Ibid.

would have to hire and train a force of competent inspectors to see that the work performed was of a sufficient quality to meet the specifications.

Many administrators often question the type of labor available to contractors under subcontracting operations. It is true that labor is usually recruited separately and renewed for each job, which means "floating help"; however, many contractors will retain key men to maintain continuity in their operations. Such temporary labor poses special problems in assessing the capacity of individuals, organizing them into teams, and controlling quality. There is also the possibility that existing employees might feel animosity toward the contractor's personnel due to fear of job loss or through jurisdictional disputes. The resulting employee friction might result in lower worker efficiency. Since all employees are interested in job opportunities, bitterness might arise as a result of the higher prevailing wages, especially in the building trades. Since the University does not have unionized workers, one serious problem in the handling of outside contracts is averted.[45]

The University might be able to force the release of an undesirable worker employed by a contractor more easily than

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[45]For details of such a case that was decided against management's right to subcontract, see p. 176, George P. Shultz and John R. Coleman, Labor Problems (New York: McGraw-Hill, 1953).

would seem to have one great area of [illegible] importance as [illegible] that the [illegible] employers [illegible] little [illegible] to meet the social actions.

Many analysts [illegible] the labor to their inability to [illegible] more [illegible] constantly [illegible], to insure that labor is usually recruited constantly and replaced for each job, which means "floating help". However, many contractors will [illegible] they can no [illegible] continuity in their operations. Each temporary labor [illegible] special problems in obtaining [illegible] in their [illegible], regulating them into homes, and maintaining quality. There is also the possibility that a single employer might lose [illegible] the contractor's [illegible] of [illegible] of [illegible] ... The remaining [illegible] action might result in [illegible] efficiency, [illegible] employees are interested in [illegible], [illegible] might arise as a result of the [illegible] prevailing wages, especially in the building [illegible] has not been [illegible] in the [illegible] of [illegible].

And [illegible] might [illegible] the [illegible] of the [illegible]

[illegible]

it could if this worker were on its own staff. As previously mentioned, Buildings and Grounds gives each worker a ninety-day surveillance period. After the ninety-day period, it is often more difficult to justify the discharge of an employee.[46] Political pressures often require an elaborate justification. However, if the employee were working for a contractor, the University might force the worker's dismissal without any direct action by the Buildings and Grounds Department. The contractor usually is cooperative in such a situation.[47]

The wages paid by the University for skilled labor are less than the union wage rate paid by most contractors as shown in Table 12. However, the contractor would not have to pay his workers for vacations and other fringe benefits. Also the contractor would not have to pay his workers for the time they lost between jobs because of faulty scheduling. These factors could quite likely increase the amount of work completed per dollar of labor cost. The contractor's labor cost could, therefore, actually be less than that paid by the University.

The hourly rate paid by the University for semi-skilled labor, such as custodians, is above that paid by either local

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[46]Interview with John A. Jacobson, August, 1961.

[47]Interview with Glenn Miner, August, 1961.

or national contractors. Using custodians as an example, the University pays these workers $1.25 per hour.[48] A contractor who does janitorial maintenance throughout the country pays his help locally $1.00 per hour. The other two large local janitorial contractors pay their workers, usually students and service men, $0.65 per hour.[49] The contractor also maintains a higher level of mechanization and more extensive training of the workers than does the University.[50] These factors result in the contractor's ability to charge the same cost per square foot for janitorial service as this service presently costs the University when it is done by the Buildings and Grounds Department. While the costs per gross square foot of floor area are identical, the contractor would service the various areas with a higher frequency as shown in Table 22 on page 127.

This cost differential will again be mentioned later in the text. An offsetting factor, however, would be that the University does not pay workmen's compensation, unemployment insurance, or does not have liability insurance.[51] Liability insurance can become quite an item for independent contractors

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48 Interview with John A. Jacobson, May, 1961.

49 Interview with Glenn Miner, August, 1961.

50 Ibid.

51 Interview with John A. Jacobson, June, 1961.

of technical achievement. [illegible]

University [illegible]

[illegible]

[illegible]

industrial [illegible]

service men, [illegible]

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of the [illegible] the University. [illegible]

result in the [illegible]'s ability to [illegible]

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costs the University [illegible]

Economic Department. [illegible]

Along with the [illegible]

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This [illegible]

the [illegible]

University [illegible]

[illegible]

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[illegible]

[illegible]

especially those who deal in hazardous work or use unskilled labor.

Buildings and Grounds does subcontract several of its maintenance tasks, aside from special peak load situations, such as the campus phone system, laundry, office machine repair, and elevator repair. This is done because these skills are not available on the present staff. The feeling towards the success of these contracts is mixed at the present time. Management should have a major interest in subcontracting, for it affects the ability of a department to provide steady employment. Since subcontracting makes it unnecessary to hire temporary employees, flexibility of operations is achieved. Whether or not widescale subcontracting is used, the occasional need for skills not readily available will always be present; therefore, some subcontracting must exist.

The consensus among the physical plant administrators contacted was that schools which make extensive use of subcontracting are not capable of coping with their maintenance responsibilities. This is rather a harsh appraisal, and it is not entirely justified. Some institutions have found that subcontracting maintenance work is less expensive than maintaining their own staff. Through correspondence with Mr. S. F. Post, the Assistant Business Manager at Stanford University,

it was discovered that even though Stanford had made extensive work studies to improve the efficiency of the maintenance workers, a janitorial contractor could still handle the sanitation maintenance at a lower cost for the same level of performance. Much of the cost savings resulted from the split shift the maintenance workers were assigned as a result of the night classes in some of the buildings. The decision in this case was not based on inability to handle a maintenance task, but rather purely on economics.

Comparing the volume of work subcontracted by the University of New Mexico with subcontracting at other universities, one should refer to Table 20. It is evident from the data presented that the majority of schools use subcontracting only for large construction or remodeling projects. Even though the volume of maintenance subcontracted by the majority of schools is not large, the University subcontracts considerably less than other schools. This lack of subcontracting has been justified by Buildings and Grounds on the basis of the excessive costs charged by contractors.[52] Another justification which has been made is the lack of continuity from project to project when contractors are used. However, there has been no detailed investigation of the possibility of subcontracting maintenance functions; therefore,

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[52] Ibid.

[illegible]

[illegible]

TABLE 20

VOLUME OF TOTAL WORK DONE BY OUTSIDE CONTRACTORS[a]

(Values in Percent)

	Group I	Group II	UNM	Group III	Group IV
Maintenance Work (e.g. Custodial Painting, Window Washing)	5.5	6.4	1.0	10.4	7.4
Operations Work (e.g. Laundry Heating Plant, Garbage Disposal)	5.1	6.7	Laundry Only	12.6	7.9
Minor Repairs and Alterations - $1,000 or less	5.2	2.7	0	6.6	14.9
Major Repairs and Alterations	43.5	43.5	0	41.3	63.1
Building Construction-$50,000 or less	85.4	68.0	0	81.8	71.8
Building Construction-$50,000 to $250,000	98.2	93.2	50.0	100.0	90.1
Building Construction-$250,000 and up	100.0	99.9	100.0	100.0	100.0

[a]Adapted from: Questionnaire and Sam F. Brewster, Organizations and Functions of Physical Plant Departments of Universities and Colleges, Kansas State University, Manhattan, Kansas, May 11, 1959.

the University still continues to acquire staff to perform all the maintenance tasks through the Buildings and Grounds Department. If the majority of institutions in the country find some subcontracting of maintenance services advantageous, it might be wise for the University to examine this method of operation also.

Thus far, most of the discussion concerning subcontracting has been rather negative. When then, assuming there is a capable maintenance administrator, has subcontracting been used extensively at such schools as Stanford? The answer is to be found in the money saved by these schools. The operating statement of the Buildings and Grounds Department of the University of New Mexico is found in Table 21. This table reflects the size of the operating budget allowed the physical plant, and any reduction in these figures should be welcomed by the University administration. Many organizations have found that, in some instances, contractors can handle maintenance services at a lower cost than they can be done by the existing plant crew. In addition to lower cost, the job is often done better since most specialized contractors make greater use of modern, labor saving equipment. In order to determine whether the University could advantageously use

the University still continues to act [illegible] in [illegible] all the maintenance [illegible] through [illegible] departments. If the University [illegible] should find some [illegible] of [illegible] it might be [illegible] for the University to [illegible] operations also.

From [illegible], much of the [illegible] concerning [illegible] has been rather [illegible]. [illegible] cases, [illegible] capable maintenance administrator, [illegible] used [illegible] to be found in the [illegible] statements of the buildings and grounds [illegible] of the University [illegible] reflects the [illegible] of the [illegible] plant, and any [illegible] by the University administration. [illegible] found that, in [illegible], [illegible] maintenance [illegible] by the [illegible] plant [illegible] more [illegible] to determine whether [illegible]

TABLE 21

EXPENDITURES BY THE UNIVERSITY OF
NEW MEXICO FOR THE OPERATION AND
MAINTENANCE OF THE PHYSICAL PLANT
(Figures in Dollars)

Expenditures	1960[a]	1959[b]	1958[b]
Administrative Office	69,827.40	50,248.56	49,274.71
Campus Planning	18,547.10	15,737.20	-----
Janitorial Service	139,625.20	127,989.16	120,001.92
Maintenance of Grounds	88,015.76	65,557.82	61,253.37
Policemen and Watchmen	40,692.67	35,128.49	32,000.36
Campus Stadium	25,682.05	-----	-----
Repairs to Buildings and Equipment	341,473.96	282,006.58	261,887.03
General Equipment	10,849.64	2,414.05	-----
Repairs to Vehicles	40,338.00	31,233.02	27,841.53
Utilities	174,037.60	163,372.84	159,520.63
Harwood Foundation	12,729.47	11,232.01	7,125.84
Property Insurance	11,011.71	15,940.74	18,723.35
Property Rental	23.82	23.82	23.82
Miscellaneous Expense	856.33	782.97	770.05
Sub Total	973,710.71	801,667.26	738,433.61
Less Charges Applied to Other Departments	162,117.21	116,189.26	89,999.43
Total Operation and Maintenance of Plant	811,593.50	685,478.00	648,434.18

[a]University of New Mexico, Financial Report, For the year ended 30 June 1960, Albuquerque, New Mexico.

[b]University of New Mexico, Financial Report, For the year ended 30 June 1959.

(figures in dollars)

Administrative Offices	[illegible]	[illegible]	[illegible]
Campus Planning	[illegible]	[illegible]	[illegible]
Custodial Service	[illegible]	[illegible]	[illegible]
Maintenance of Grounds	[illegible]	[illegible]	[illegible]
Policemen and Watchmen	[illegible]	[illegible]	[illegible]
Campus Studies	[illegible]	[illegible]	[illegible]
Repairs to Buildings and Equipment	[illegible]	[illegible]	[illegible]
General Equipment	[illegible]	[illegible]	[illegible]
Repairs to Utilities	[illegible]	[illegible]	[illegible]
Utilities	[illegible]	[illegible]	[illegible]
Garbage Collection	[illegible]	[illegible]	[illegible]
Property Insurance	[illegible]	[illegible]	[illegible]
Property Rental	[illegible]	[illegible]	[illegible]
Miscellaneous Expenses	[illegible]	[illegible]	[illegible]
Sub Total	[illegible]	[illegible]	[illegible]
Less Charges Credited to Other Departments	[illegible]	[illegible]	[illegible]
Total Operation and Maintenance of Plant	[illegible]	[illegible]	[illegible]

[illegible]

contracts for any of its maintenance requirements, the several maintenance groupings will be examined.

The cost comparisons used in this paper are unrealistic in one aspect: that is, they do not carry the proper burden for overhead. The overhead for maintenance operations at the University was said to be eight to eighteen percent.[53] This estimate contrasts with the applied general overhead assigned to the heating plant in 1960 of 5.3 percent of operation and maintenance expenditures.[54] The overhead assigned to University contract research is approximately thirty percent. Since no accurate overhead evaluation for the Buildings and Grounds Department was available, the overhead allotted to physical plant departments at other institutions was investigated. Very few schools actually determine an overhead burden for their maintenance work. If they do find this figure, they are quite reluctant to release it. Davidson College seemed to use approximately fifteen percent for their physical plant overhead.[55] Other papers presented on maintenance expenses also favored a figure of fifteen percent.[56] This fifteen percent allowance

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[53] Ibid.

[54] Adapted from the Financial Report, 1960.

[55] Adapted from F. D. Hobart.

[56] National Association of Physical Plant Administrators of Universities and Colleges, Minutes of the Forty-seventh Annual Meeting (Boston: National Association of Physical Plant Administrators, 1960).

contracts for any of its maintenance requirements, the several maintenance groupings will be examined.

The cost comparisons used in this paper are unrealistic in one aspect; that is, they do not carry the proper burden for overhead. The overhead for maintenance operations at the University was said to be eight to eighteen percent.[36] This estimate contrasts with the applied general overhead assigned to the heating plant in 1962 of 3.5 percent of operation and maintenance expenditures.[37] The overhead assigned to University contract research is approximately thirty percent. Since no accurate overhead evaluation for the Buildings and Grounds Department was available, the overhead allotted to physical plant departments at other institutions was investigated. Very few schools actually determine an overhead burden for their maintenance work. If they do find this figure, they are quite reluctant to release it. Davidson College seemed to use approximately fifteen percent for their physical plant overhead.[38] Other papers presented on maintenance expenses also indicated a figure of fifteen percent.[39] This fifteen percent will be

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[36]Ibid.

[37]Computed from the Financial Report, 1962.

[38]Estimated from ..., p. ...

[39]National Association of Physical Plant Administrators of Universities and Colleges, Minutes of the ... Annual Meeting (..., National Association of Physical Plant Administrators, 1961).

for overhead is within the range of eight to eighteen percent set forth by Mr. Jacobson; therefore, a fifteen percent allowance will be assumed to be valid. However, since there is no accurate overhead evaluation by the University for the Buildings and Grounds Department, this additional cost has been omitted from the following cost estimates. One should bear this in mind throughout this discussion.

"It is wise to handle your own dirty linen," is a saying which could serve as justification for the University's security forces. There has to be a special kind of understanding and technique used by the campus police, especially in the spring when "the sap begins to rise." This coupled with the average pay scale of $3400.00 per year[57] might account for the fact that the security force is the greatest problem constantly facing the Buildings and Grounds Department.[58] An interesting comparison would be to evaluate the effectiveness of the security force brought in for use at the Winrock Shopping Center. The jurisdictional problems are similar since the center is on University land. Certainly a student on a "panty raid" could be no more determined or obnoxious than an oblivious mother with three small companions on "double stamp day."

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[57]Interview with John A. Jacobson, August, 1961.

[58]Ibid., April, 1961.

for each one to fall within the range of eight to eighteen percent set forth by the Academic Operations, a [illegible] ten percent allowance will be assumed to be valid. However, since there is no accurate or exact evaluation by the University of its buildings and grounds department, this administrative cost has been omitted from the following cost estimates. One should bear this in mind throughout this discussion.

"It is hard to handle your security alone," is a saying which could serve as justification for the University's security forces. There has to be a special kind of understanding and technique used by the campus police, especially in the spring when "the sap begins to rise." This coupled with the average pay scale of $5100.00 per year[1] might account for the fact that the security force is the greatest problem constantly facing the buildings and grounds department. An interesting comparison would be to evaluate the effectiveness of the security force with that of the one at the [illegible] Shopping Center. The pay [illegible] and uniforms are similar since the contract is on University land. Generally a student at a party [illegible] would [illegible] than an [illegible] [illegible] than [illegible] [illegible] company.

[1]Interview with [illegible], Director of Security, [illegible], 1971.
[illegible], 1971.

The contractor's police seem to be effective at present. Discussions with merchants in the Winrock Shopping Center have revealed that, in general, the merchants are quite pleased with the security services now offered by the William J. Burns International Detective Agency. The local Burns representative, Mr. J. Salmon, pointed out that the only problem his men have encountered at the Winrock Center is that of traffic control. If a traffic violation is observed, it is ignored.[59] The contractor's police have no authority to issue tickets, and neither a Justice of the Peace nor the City Traffic Court will admit jurisdiction over the property; therefore, the violation is not prosecuted. The University police force has solved this problem by obtaining the authority to issue traffic tickets of the City Police; and these tickets, in turn, are tried by the City Traffic Court. The Campus Police also is allowed to use the city's police radio.[60] Assuming that security forces of a contractor would have the same privileges, these Burns men could be substituted for the present Campus Police Force. Since the Burns Agency attempts to screen their men carefully, the question of whether to subcontract campus security forces becomes a question of economics.

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[59]Interview with Mr. J. Salmon, The William J. Burns International Detective Agency, Inc., August, 1961.

[60]Interview with John A. Jacobson, August, 1961.

The average salary paid to the eight campus policemen is $3400.00 per year per man plus a fifteen dollar per month allowance for uniforms.[61] Assuming the policemen work an eight hour day and 220 days per year, the hourly cost per policeman for salary and uniforms alone is $2.03. Eight men at this rate plus the chief and a student working half time would result in a yearly cost for salaries and uniforms of $35,832.40.[62] The total cost for policemen and watchmen in the University budget is $40,692.67, which includes the cost of police vehicles and temporary city police at various University functions as football games. These temporary police are hired at $2.20 per hour.[63]

The cost of police protection is $1.80 per man hour at the Winrock Center.[64] This cost is based upon the geographical location of the installation rather than the number of personnel involved.[65] This hourly rate covers all insurance, bonding costs, and uniform allowances also. The University could

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[61] Ibid.

[62] Adapted from data on the Questionnaire.

[63] Interview with John A. Jacobson, August, 1961.

[64] Interview with J. Salmon, August, 1961.

[65] Ibid.

The average salary paid to the eight campus policemen is $6500.00 per year per man plus a mileage [illegible] allowance for uniforms.[60] Assuming the policemen work an eight hour day and 250 days per year, the hourly cost per policeman for salary and uniform alone is $3.25. Fifteen men at this rate plus the chief and a student secretary full time would result in a yearly cost for salaries and uniforms of $15,[illegible].00.[61] The total cost for policemen and equipment in the University budget is $90,000.00, which includes the cost of patrol vehicles and temporary city policemen during University functions at football games. These temporary police are hired at $3.00 per hour.[62]

The cost of police protection is $3.50 per man hour at the Lincoln Campus.[63] This cost is based upon the geographical location of the installation rather than the number of personnel involved.[64] This hourly cost covers all insurance, vehicle costs, and uniform allowances also. The University pays

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[60] Ibid.

[61] Computed from data on the questionnaire.

[62] Interview with John [illegible], [illegible], 1961.

[63] Interview with [illegible], 1961.

[64] Ibid.

immediately realize a savings of $0.40 per hour by using these men when temporary police are desired. However, there would also be a savings of $0.23 per hour over the present campus police cost for salaries and allowances alone if this service were contracted. Using the previous criteria for determining the total hours worked, this savings would amount to at least $3441 per year, assuming that the University retained its own chief. This is one area the Administration might investigate since the method of operation would have little effect upon the over-all maintenance program.

Buildings and Grounds maintains eight station wagons and sedans which it "rents" to the various departments at seven cents a mile including gasoline and oil. These vehicles are driven approximately 60,000 to 75,000 miles per year. At the end of two years they are traded in for new models. Balancing the vehicle rent revenue against the out-of-pocket maintenance expense and the acquisition cost, again neglecting overhead, these automobiles show a slight profit.

The city rents police cars from Frontier Ford at a price of approximately $173 per month, a figure which would tentatively apply to University rentals also.[66] These rentals run upwards of 90,000 miles yearly and are exchanged yearly

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[66]The Albuquerque Tribune, June 5, 1961, p. A-2.

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Buildings and Grounds maintains eight station wagons and sedans which it 'rents' to the various departments at seven cents a mile including gasoline and oil. These vehicles are driven approximately 50,000 to 75,000 miles per year. At the end of two years they are traded in for new models. Balancing the vehicle rent revenue against the out-of-pocket maintenance expense and the acquisition cost, again neglecting overhead, these automobiles show a slight profit.

The city rents police cars from Frontier Ford at a price of approximately $173 per month, a figure which could tentatively apply to University rental fees.[56] These rentals run upwards of 30,000 miles yearly and are exchanged yearly

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[56] The Albuquerque Tribune, June 5, 1961, p. A-1.

for new models.[67] On the basis of a twelve month's usage, the cost per mile paid by the city is 2.3 cents. Adding the figure given by the American Automobile Association of thirty dollars per one thousand miles for car operating expenses (e.g. gasoline, oil, lubrication, and so on), the cost per mile becomes 5.3 cents. Some additional amount would have to be estimated for major repairs and insurance to increase this figure accordingly. Unfortunately these data are not available at the present time. It might be advantageous for the University to investigate leasing its automobiles on open bids and exchanging them each year.

In an investigation for Sandia Corporation, Dr. A. T. Steele found through analytical means that the old rule of thumb of trading off an automobile after six years or 60,000 miles was valid. This was a rather extensive study made possible by the detailed cost records kept by the Federal Government on all their vehicles. In addition to the maintenance costs on the vehicles, which were expressed as both a function of the age and the mileage driven, the cost of new vehicles and also the trade-in values at various vehicle ages and mileages were considered. After the material was compiled and the relationships were introduced to the

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[67] <u>Ibid</u>.

for new schools. [illegible] Board's [illegible] estimates [illegible] by the city [illegible]. [illegible] the figures [illegible] as [illegible] in the [illegible] (e.g. guidance, art, kindergarten, and so on), the [illegible] become [illegible]. Some additional amount should be estimated for major repairs and increased [illegible] figures accordingly. Unfortunately these data are not available at the present time. It might be worthwhile for the [illegible] each year.

[illegible] through [illegible] that the old rule of thumb of [illegible] after six years [illegible]. This [illegible] by the [illegible] of the [illegible] [illegible].

computer, the result of the study confirmed the six year or 60,000 mile trade-in rule. That is the point where maintenance expenses begin to overbalance the worth of the automobile. This would occur at the end of one year for the University. If true overhead were available for the automotive shops, the "profit" might be erased and the prospect of leased vehicles would appear brighter.

The special purpose vehicles are at a stage now where the age of many of them makes finding replacement parts difficult. Undoubtedly the automotive shops of the Buildings and Grounds Department could be kept busy just maintaining these vehicles and some of the "octogenarian" trucks. This seems to be a rather high price to pay, even though a truck body rarely wears out. The high amount of maintenance observed on some of these vehicles, though only some records were available, shows them to be almost past the point of diminishing returns. The maintenance records which were available on each vehicle consisted of a notebook in which the purchase price of each part added to the vehicle was recorded. While this is better than no records at all, it does not make any allowance for the labor cost associated with a particular repair. A task such as replacing a transmission or relining the brakes usually results in a

computer, the result of the study confirmed the six year or 60,000 mile trade-in rule. That is the point where maintenance expenses begin to overbalance the worth of the automobile. This would occur at the end of one year for the University. If time overhead were available for the automotive shop, the "profit" might be erased and the prospect of leased vehicles would appear brighter.

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greater cost for the labor than for the part. This can be quickly seen in any automobile company's "Flat Rate Manual" which establishes the proper cost estimation for their mechanics. Truck rental would cost about five to seven cents a mile and might also result in a savings over the present system.

Landscaping and grounds maintenance pose several problems. As things now stand, these workers are used as a reserve labor pool and work where they are needed, such as roofing installation. This is a satisfactory arrangement, and the cost of grounds care is not excessive. The maintenance cost for an acre of grass is $670 per year, $390 per year of which is for water.[68] The University maintains its own wells through the heating plant and obtains its water at a cost of eight cents per thousand gallons versus the city's rate of seventeen cents per thousand gallons.[69]

If, however, the scheduling were such that these employees had an excess of "free time," several national contractors could handle this job as they do on many military installations. While the estimate was requested to be confidential, one contractor said that he could do the job

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[68] _Ibid._, May 15, 1961, A-7.

[69] Interview with John A. Jacobson, June, 1961.

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Landscaping and grounds maintenance pose several problems. As things now stand, these workers are used as a reserve labor pool and work where they are needed, such as roofing installation. This is a satisfactory arrangement, and the cost of grounds care is not excessive. The maintenance cost for an acre of grass is $570 per year, $190 per year of which is for water.[68] The University maintains its own wells through the heating plant and obtains its water at a cost of eight cents per thousand gallons versus the city's rate of seventeen cents per thousand gallons.[69]

If, however, the scheduling were such that these employees had an amount of "free time," several national contractors could handle this job as they do on many military installations. While the estimate was requested to be confidential, one contractor said that he could do the job

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[68]*Ibid.*, May 15, 1961, A-7.

[69]Interview with John A. Dickinson, June, 1961.

at a reasonable savings to the University. Any maintenance service where the men are idle a portion of the time is expensive. Usually a subcontractor can furnish a part-time crew to do such a job at a lower cost than the University would now pay. The contractor supplies men only as needed, and the University is not saddled with the problem of finding jobs for the six men not needed for landscape and grounds maintenance during the winter. Contracting this service could be feasible, if the University felt such a policy were advisable.

Sanitation maintenance is probably the most likely contender for a maintenance contract. Referring again to Table 21, janitorial services comprise over seventeen percent of the Buildings and Grounds Department budget. A cut in the cost of this service could prove quite worthwhile.

Reading back over papers presented on janitorial work, only two facts become evident.[70] One is that janitorial service is never satisfactory, and the second conclusion is that the reason for this is the low pay received by these employees. Low wages are more of an alibi than a conclusion. Janitorial service is usually what the administration wants

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[70]These conclusions were obtained from the Minutes of the National Association of Physical Plant Administrators and Techniques of Plant Maintenance and Engineering.

of a noticeable savings to the University. Any saving would [illegible] where [illegible] the [illegible] of the [illegible] operations. [illegible] them to do such a job at a lower cost than the University would now pay. The contractor would [illegible] only as needed, and the University is not [illegible] with [illegible] for the [illegible] for [illegible] and [illegible] during the [illegible]. Consequently, this [illegible] would be feasible. If the University felt such a policy were advisable.

[illegible] maintenance is probably the most likely candidate for a [illegible] contract; [illegible] again is [illegible]. [illegible] over [illegible] because of the [illegible] and [illegible] departmental budgets. [illegible] is the type of [illegible] contracting.

[illegible] to industrial work, only two [illegible] [1] [illegible] that is, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible]

[illegible] of [illegible] in [illegible] and [illegible].

it to be, or what it is willing to pay for. At the University, the custodial budget is constantly robbed so as to devote more funds to other projects. This results in a poorly trained janitorial force, somewhat lacking in equipment and spread out so as to cover about 15,000 square feet per man, a large area for even an efficient, well-trained and equipped custodian.[71]

One consulting firm, by applying job method analysis, work measurement, and scheduling to janitorial work has provided annual savings amounting to tens of thousands of dollars for numerous large office buildings and, at the same time, increased wages, sustained good morale among the janitors, and improved the quality of the building maintenance.[72] These are the techniques used by the large scale, and successful, janitorial contractors. The contractors can usually supply better quality maintenance than most custodial departments because they are better equipped and trained. And finally, the cost for the contractor's service is usually lower than the cost of the institution's own janitorial department.

To find out if a savings to the University would result from contracting this service need, a cost study would have

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[71]Interview with John A. Jacobson, April, 1961.

[72]James L. Lundy, Effective Industrial Management (New York: The MacMillan Company, 1957), p. 179.

it to be, or what it is willing to pay for. At the University, the custodial budget is constantly being [illegible] so as to devote more funds to other purposes. This requires [illegible] of poorly trained janitorial force, however, lacking in equipment and spread out so as to cover about 18,000 square feet per man, a large area for even an efficient, well-trained and equipped custodian.[74]

One consulting firm, by applying job methods analysis, work measurement, and scheduling to janitorial work, has provided annual savings amounting to tens of thousands of dollars for numerous large office buildings and, at the same time, increased wages, sustained good morale among the janitors, and improved the quality of the building maintenance.[75] These are the techniques used by the large-scale, and successful, janitorial contractors. The contractors can usually supply better quality service than most custodial departments because they are better organized and trained. And finally, the cost for the contractor's service is usually lower than the cost of the institution's own janitorial department.

[illegible]

[illegible]

[74] [illegible]

[75] [illegible]

to be made. In studying cost data reduced to a cost per square foot basis from other universities, the only evident conclusion is that everyone operated using a different sized square foot. This may not be as peculiar as it sounds, for the American Institute of Architects' standard area measurement is based on outside wall dimensions; therefore, several people could measure the same building and come up with four entirely different custodial cleaning areas by using net dimensions, gross dimensions, or including wall and furniture surfaces, and so on.

The estimated annual cost of janitorial work at the University is nineteen cents per square foot.[73] This cost was said to be based upon the American Institute of Architects' figure of gross floor area for the University. Yet this gross floor area is 1,595,600 square feet.[74] This would result in a total janitorial cost of $303,164. Even if only the floor area used primarily for academic purposes and the floor area of the dormitories (864,800 and 300,700 square feet respectively[75]) is considered, the custodial cost would be $244,755 per year. The University's janitorial costs were

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[73]Interview with John A. Jacobson, April, 1961.

[74]Information found on the Questionnaire.

[75]Ibid.

to be made. In the plant cost area [illegible] cost per square foot basis from other universities, the only [illegible] conclusion is that everyone means something different by a square foot. This may not be as peculiar as it sounds. As the American Institute of Architects' [illegible] measure-ment is based on outside wall dimensions, for example, several people could measure the same building and come up with [illegible] entirely different [illegible] by using wall dimensions, gross [illegible] surfaces, and so on.

The estimated annual cost of janitorial service in the University is [illegible] cents per square foot. This cost was said to be based upon the American Institute of [illegible] figure of gross floor area for the University. Actually gross floor area is [illegible] square feet. [illegible] a total janitorial cost of [illegible] area used primarily for academic [illegible] of the dormitories ([illegible] square feet, respectively[illegible]) [illegible] per year. [illegible]

[illegible]

[illegible]

[illegible]

$139,625.20 in 1960 which corresponds to neither of the above figures.[76] Therefore, either the method of establishing the floor area maintained or the cost estimate of $0.19 per square foot is erroneous. The $0.19 custodial cost per square foot is well-established in institutional maintenance. This is the cost used by the Texas Legislature to apportion custodial budget allotments among the various institutions of higher learning.[77] Therefore, the basis of measurement of floor area must be different from the accepted standard set up by the American Institute of Architects.

It is probable then that the area under frequent custodial service is cleaned less frequently than a desirable minimum for proper sanitation. (See Table 22, page 127.) In other words, almost half of the buildings on the campus are receiving inadequate janitorial service.

A nationally known custodial contractor, familiar with the University, gave an estimate of eighteen cents a square foot and mentioned if there appeared to be competition in the bidding that he had a margin with which he could reduce

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[76]Financial Report, 1960, p. 19.

[77]W. H. Badgett, "A Formula Approach to Physical Plant Budgeting," Manager of Physical Plant (The Agricultural and Mechanical College of Texas, 1959). (Mimeographed.)

$138,625.20 in 1960 which corresponds to neither of the above figures.[76] Therefore, either the method of establishing the floor area maintained or the cost estimate of $0.19 per square foot is erroneous. The $0.19 custodial cost per square foot is well-established in institutional statistics. This is the cost used by the Texas Legislature to apportion custodial budget allotments among the various institutions of higher learning.[77] Therefore, the basis of measurement of floor area must be different from the accepted standard set up by the American Institute of Architects.

It is probable then that the area under permanent custodial service is cleaned less frequently than a desirable minimum for proper sanitation. (See Table 72, page 127.) In other words, almost half of the buildings on the campus are receiving incomplete janitorial service.

A nationally known custodial consultant, familiar with the University, gave an estimate of [illegible] cents a square foot and mentioned if these [illegible] to be competitive in the building then he had a margin upon which he could [illegible]

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[76] Plans and Reports, 1960, p. [illegible].

[77] L. L. [illegible], "[illegible] Approach to [illegible]," [illegible] (Austin: University of Texas, [illegible]), [illegible].

the figure probably a cent per square foot lower. This contractor would follow specifications and recommended frequency of service as found in Appendix I, page 125, and Table 22, page 127. At present the recommended frequency of service is not totally adhered to. This would amount to an annual savings of around $10,000 if the differential were only one cent per square foot. A savings of this magnitude would be a desirable possibility for the University and should not be overlooked.

The University of Maine has investigated custodial contracting as have other schools, and all have found the prospect highly promising.[78] As previously mentioned, Stanford contracts with American Building Maintenance and is quite satisfied with this arrangement. A closer examination of the situation at Stanford might be enlightening. The campus contains a total net floor area of 2,623,194 square feet, of which 1,633,066 square feet are primarily used for academic purposes and 901,957 square feet are in the dormitories.[79] The administration at this institution faced a problem similar to that of the University of New Mexico. With an extensive graduate program at night, it was

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[78]National Association of Physical Plant Administrators, p. 110.

[79]Adapted from the Questionnaire reply.

difficult to service the buildings with custodians since some buildings were cleaned in the early evenings and some buildings were cleaned after the night classes were dismissed. It was difficult to hire custodians to work after midnight or on a split shift. Therefore, Stanford contacted American Building Maintenance, a national concern, which was doing other work in the local area. American Building Maintenance now handles eighty percent ($350,000) of the university's custodial work.[80] The company brings in one set of workers in the evening for four hours and then uses them for other local concerns for the other four-hours. After midnight another group of custodians finishes the janitorial work on the campus during another four hour shift.[81] This arrangement has worked quite well. The cost of this maintenance service is $0.157 per net square foot.[82]

Stanford also subcontracts the following services: 25% of the painting, 100% of the window washing, 100% of the laundry, 95% of the garbage and trash collections, 100% of the office machine repair, 100% of the refrigeration

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[80] _Ibid._

[81] National Association of Physical Plant Administrators, p. 104.

[82] Adapted from the Questionnaire reply.

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[90] Ibid.

[91] [illegible], [illegible], op. cit., [illegible] p. 309.

[92] Adapted from an unpublished study.

maintenance, and 100% of the pest control.[83] Stanford has been quite satisfied with the results of this program.

Moreover, a recent development in subcontracting custodial services has taken place at Fort Lewis A & M College in Colorado. An Albuquerque concern has been given the janitorial contract for the 1961-62 school year. After Stanford's success with janitorial contracts, Colorado is using this junior college as a source for data to determine the feasibility of contracting the janitorial services at all Colorado institutions of higher learning.[84]

Not only might the University find contractual janitorial service more economical, but also the probability is great that the level of service would be superior to that existing at the University now. Subcontracting custodial services at least bears investigation as a possible source of savings.

Two groups of maintenance services were not covered in the previous discussion. These are the mechanical and electrical division and the building trades skills. At the present time, observations tend to show these two groups to be the most effective on the campus.

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[83]Answers on the Questionnaire.

[84]Interview with Glenn Miner, August, 1961.

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[83]Answers on the questionnaire.

[84]Interview with Glenn Miner, August, 1961.

Investigations have failed to discover any institutions or government agencies subcontracting mechanical and electrical maintenance work, other than in some military housing areas. Furthermore, local contractors had little interest in bidding on this type of maintenance work. These contractors felt that since they were unfamiliar with the University's facilities and problems, a price could not be quoted which would be competitive with the present Buildings and Grounds Department. Another problem faced by the contractors was the prospect of variable, unpredictable work loads. This would cause unwanted fluctuations in the contractor's labor force.

On the other hand, the building trade skills, while possibly not as competent as the previous group, would easily be adaptable to subcontracting since this is quite common in the construction industry. The lack of building continuity and communication has been discussed previously; however, there is another factor which could eliminate this group from consideration also. It has often been said that it is cheaper to build a new house than remodel an old one. This axiom also holds for university buildings. Many times the contractor has no way of knowing the difficulties which may be encountered in a building; therefore, if it is on a fixed fee contract, the contractor will bid higher to cover any

Investigations have failed to discover any institution or government agency [illegible] electrical maintenance work. Other than in one military housing area, furthermore, local contractors had little interest in bidding on this type of maintenance work. These contractors felt that since they were unfamiliar with the University's facilities and problems, a price could not be quoted which would be competitive with the present buildings and grounds department. Another problem faced by the contractors was the unpredictable, [illegible] work loads. This would cause [illegible] fluctuations in the contractor's labor force.

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contingencies. The "padded" fixed fee bid might be avoided by using the cost-plus-fixed-fee system. Often, however, managements become careless in their spending and accounting under cost-plus-fixed-fee contracts. The Federal Government uses the General Accounting Office to ferret any abuses of such a contract; however, the University has no such agency on which to depend. The Buildings and Grounds Department presently uses subcontractors for work which exceeds a cost of $50,000.

If subcontracting maintenance work were begun on a small scale as, for example, a window washing contract, the University would have the opportunity to evaluate properly the cost and performance of such contracts. Not only would knowledge be gained in the operation of such contracts, but also in writing specifications and estimating costs for the contracts. After this period of evaluation, specifications might be written to cover the mechanical and electrical work and also the building trades skills. With these accurate requirements, the University might interest contractors in bidding on such maintenance work.

Minimum Performance Specifications

To obtain competitive costs and satisfactory job performance, a detailed set of specifications is necessary.

contingencies. The greatest [illegible]

by using the [illegible],

management [illegible]

under [illegible]. The [illegible]

uses the General Accounting Office [illegible]

with a contractor, however, the University [illegible]

on which to depend. The [illegible]

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If manufacturing [illegible]

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University would have the opportunity [illegible]

the cost and performance of such [illegible]. Not only would

knowledge be gained in the [illegible], but

also in writing specifications and [illegible] for the

contracts. [illegible]

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and also the [illegible]. With [illegible]

requirements, the University [illegible]

bidding on such [illegible].

[illegible]

[illegible]

[illegible]

Appendix I, page 125, contains a set of typical specifications prepared for two areas of maintenance services, sanitation maintenance and landscape and grounds maintenance. These two areas appeared to have the greatest potential as possible service contracts. The specifications as prepared are rather general; however, they should give an indication of the general outline and form that such a document should follow. Also included is Table 22, page 127, which gives an indication of the frequency at which the janitorial tasks should be performed.

Other Important Factors for Consideration

Some of the labor problems connected with subcontracting have already been mentioned. The current employee displaced through a service contract could be a problem. The majority of employees could, no doubt, be either relocated within the department or absorbed through normal attrition. This would be especially true if a program of subcontracting were started gradually as mentioned before. As a last resort an employee might be laid off with some settlement such as severance pay.

Taking care of displaced employees is not always as simple as it sounds. A custodial contract was let for Kirtland Air Force Base in Albuquerque, and all parties

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Other Important Factors for Consideration

Some of the labor problems connected with subcontracting have already been mentioned. The current employees displaced through a service contract could be a problem. The majority of employees would, no doubt, be either relocated to other departments or absorbed through normal attrition. This would be especially true if a program of subcontracting were started gradually at [illegible] intervals. In a large university, employees might be laid off with some [illegible] short of [illegible].

[illegible]

concerned agreed that the contractor was supplying superior maintenance at a lower cost.[85] However, natural turnover did not remedy the surplus personnel problem: the employees had too many years of service to be released; and they did not respond to retraining. The administration at Kirtland did not feel they could justify firing the employees for mediocre performance since they could not prove absolute incompetence. The net result was that the Government had to cancel the contract, for one inefficient janitorial crew is still more economical than two janitorial staffs.

The question of whether a contractor would offer a higher level of performance is difficult to answer. The contractor's employees would not have the pride in and loyalty to the University that permanent employees might have; therefore, the quality could conceivably be lower. In many instances, however, the contractors train their men more extensively; therefore, the contractor's employees could possess a higher level of skill. Also, the University might be able to apply more pressure on the contractor and his employees than they could to their own. Finally, the possibility of a performance bond could give a request for quality

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[85] Ibid, October, 1960.

concerned agreed that the contractor was supplying support maintenance at a lower cost.[12] However, natural turnover did not remedy the surplus personnel problem; the employees had too many years of service to be released, and they did not respond to retraining. The administration at Virginia did not feel they could justify firing the employees for mediocre performance since they could not prove their incompetence. The net result was that the decision was made to cancel the contract, for one institutional custodial crew is still more economical than two janitorial crews.

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much impetus. The whole question of quality would really rest with the University's inspector, for it would be his responsibility to see that the job was done right.

In passing, if a large portion of the maintenance work were let out on contracts, the vacant space in the existing physical plant building could be utilized for academic purposes.

Finally, one should not forget that this University is state supported. The thought of a state institution reducing its payroll might well cause repercussions as high as the Board of Educational Finance. Since the staff of the University would be reduced, should its appropriations also be reduced? As previously mentioned, there is a considerable amount of political influence exerted at the present time in hiring policies, so while this factor is not the controlling one, it certainly deserves some thought.

There are many arguments, both for and against, subcontracting the maintenance functions of the Buildings and Grounds Department. However, the decision of whether or not to subcontract maintenance services should be based primarily on the amount of money that would be saved. Therefore, a summary of the savings immediately possible through subcontracting will be made.

[illegible] the University's [illegible]

In [illegible] physical plant [illegible]

Finally, [illegible]

[illegible]

The text pointed out previously that the University could save $3,441 per year by using police furnished by the William J. Burns Agency. Custodial costs could be reduced by $10,000. Assuming a conservative figure for the annual mileage of the University's eight automobiles and station wagons, there would be a $14,000 saving (60,000 x 8 x 0.03) by leasing the automobiles. If the vehicles were traded at 60,000 miles, the maintenance costs would be reduced by twenty percent.[86] The savings on vehicle repairs then would be $8,068 per year.[87] Finally, using a ten percent reduction in the cost of grounds maintenance for the 100 acres under intensive maintenance, the savings would be $2,800.[88] The yearly savings to the University by subcontracting these maintenance services would be $38,709. This is 4.8% of the total cost of operation and maintenance of the plant.[89]

Subcontracting might offer some opportunities to reduce maintenance expenditure; however, the University must decide whether to divide the maintenance responsibility among the contractors or centralize this function in the Buildings and Grounds Department.

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[86] Interview with J. C. Hart, June, 1961.

[87] Adapted from the Financial Report, 1960, p. 19.

[88] Answer from the Questionnaire.

[89] Adapted from the Financial Report, 1960, p. 19.

[illegible]

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CHAPTER IV

RECOMMENDATIONS AND CONCLUSIONS

Like anything else, the Buildings and Grounds Department of the University of New Mexico is neither all good nor is it all bad. However, as in any complex organization, improvements can be made. At present the supervision of the department is dedicated and conscientious. The management has been given such heavy work loads, though, that it has not had any time to make a critical self-appraisal.

Probably the greatest need of the Buildings and Grounds Department at the present time is the installation of an integrated maintenance control program. The first step in this program would be a complete evaluation of the present maintenance system, including its goals, responsibilities, and operating methods. After this examination is evaluated, an integrated maintenance system should be put in force, whether the work is performed by the University's staff or by contractors.

The first phase of a comprehensive maintenance program would be the installation of a systematic preventive maintenance program, which should soon pay for itself. If the University

CHAPTER [illegible]

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Probably the greatest need of the Physical Plant Department at the present time is the institution of an integrated maintenance control program. The first step in this program would be a complete evaluation of the present maintenance system, including its goals, procedures, and operating methods. After this evaluation is completed, an integrated maintenance system should be set up to [illegible] the work is performed by the [illegible] personnel.

[illegible]

intends to increase the efficiency of its physical plant maintenance, a system of cost accounting and control is needed. This system would provide records with which a true evaluation of controllable and uncontrollable costs could be made. The records would also supply a means of properly evaluating maintenance efficiency. Also a scheduling system is needed so that at least eighty percent of every worker's time is accounted for in advance; this will prevent useless delay and needless shuffling of workers. The cost control system should also place each academic and administrative department in the University on a maintenance budget, a step which would alleviate some existing friction over potential projects. Finally, industrial and engineering techniques could be fitted into the maintenance program through adequate job training. These steps, as pointed out previously, should bring a twenty-five percent reduction in the University's maintenance costs.

Another way of dealing with the University's physical plant program would be through subcontracting several of its service needs. The multitude of problems confronting both the University and a contractor would probably render the mechanical and electrical maintenance and the work done by the building trades skills unsuitable at the present time for contract considerations. The janitorial services,

landscape and grounds maintenance, police, and the automotive vehicles could be handled by contractors for an expenditure of 3.8% less than that now allotted.

The whole maintenance problem is one of University policy. The administration must decide whether it will maintain its rapidly expanding physical plant by: 1) retaining the present system; 2) retaining the present Buildings and Grounds Department; however, initiating a program of continuous improvement through the use of a comprehensive maintenance control system; 3) dividing the maintenance responsibility among the Buildings and Grounds Department and outside contractors; or 4) possibly subcontracting the entire maintenance responsibility.

The initial investigation of this problem was made with the thought that it might be advantageous to eliminate the entire Buildings and Grounds Department. However, after further investigation, the realization came that the present department has a fine core of workers and supervisors, and the University would gain little by their dismissal. It was also discovered that in most instances subcontracting maintenance work did nothing to solve the real, existing problems such as improper scheduling. The solution to these problems was simply postponed for some indefinite period. Therefore, the

landscape and grounds maintenance, and only a few motor [illegible] vehicles could be [illegible] for [illegible] of this [illegible] [illegible].

The whole maintenance problem is one of [illegible]. The administration [illegible] is only [illegible] rapidly expanding physical plant by: 1) retaining [illegible] system; 2) retaining the present buildings and grounds department; however, initiating a program of maintenance improvement through the use of a [illegible] control system; 3) dividing the [illegible] responsibility among the buildings and grounds department and outside contractors; or 4) possibly [illegible] the entire [illegible] responsibility.

The initial investigation of this [illegible] the thought that [illegible] the entire buildings and grounds department [illegible]. further investigation, [illegible] university [illegible] little [illegible] [illegible]

recommendation of this study is not that the University supplant its Buildings and Grounds Department responsibilities with maintenance contracts, but rather that the University initiate an improvement program using the existing organization. Comprehensive improvements in the methods of the Buildings and Grounds Department should result in a twenty-five percent cost reduction while the cost reduction through subcontracting would be less than five percent. Such a maintenance control program should quickly show results in the form of cost reductions and a higher quality of maintenance work.

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APPENDIX I

The specifications which follow cover the minimum Federal Government performance levels for sanitation maintenance. Specifications of this type would be necessary for all maintenance functions if the University chose to subcontract its physical plant maintenance. The specifications were adapted from U. S. Government invitations to bid and information received through personal interviews.[1-4]

These specifications attempt to accomplish three functions. First, the specifications define the service need. For example, what is meant by window washing is

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[1] Interviews with Glenn Miner, October, 1960, March, 1961, April, 1961.

[2] Interviews with John A. Jacobson, April, 1961, May, 1961, June, 1961.

[3] Interview with J. C. Hart, June, 1961.

[4] U. S. Government Invitations to Bid, IFB 08-602-60-32 (MacDill Air Force Base, Florida), May 5, 1960.

________, Purchase Authorization AFR 67-3 Par 50 (5), IFB 08-602-60-31 (MacDill Air Force Base, Florida), May 5, 1960.

________, IFB 9M 09-030-60-60, Atlanta General Depot, U.S. Army (Forest Park, Georgia), May 31, 1960.

________, Specification #P. 65, Specifications for Janitorial Services for United States National Aeronautics and Space Administration, Wallops Station (Wallops Island, Virginia), June 2, 1960.

________, IFB, QM-44-055-60-109, Custodial Services for WAADS (Fort Lee, Virginia).

[illegible]

[illegible]

[illegible]

defined. Instructions are given on the proper method of performing a service need along with the necessary equipment required and safety precautions. Second, the definition of the minimum cleanliness is stated. In other words, what constitutes a properly cleaned window? Finally, the proper frequency of service is set forth. The frequency of service requirements are summarized in Table 22. One item is not covered by these specifications, the requirements for the type of supplies to be used, such as floor waxes. These requirements, while usually considered as separate specifications, would be important if the University were to invite bids on subcontracting sanitation maintenance functions.

The Buildings and Grounds Department of the University conforms to the first two functions of the specifications as mentioned above. When the various service needs are performed about the campus, they are usually done properly. However, Table 22 indicates some of the problems of sanitation maintenance at the University. The recommended frequency of service is not followed as closely as necessary for proper sanitation maintenance. Table 22 is based upon average service given about the campus. Buildings and Grounds presently determines the frequency of service by an estimation of the usage of individual buildings. Therefore, the Administration Building

defined. Instructions are given as the proper method of performing a service used along with the necessary equipment required and safety precautions. Second, the definition of the minimum cleanliness is stated. In other words, what constitutes a properly cleaned window? Finally, the minimum frequency of service is set forth. The frequency of service requirements are summarized in Table 22. One item is not covered by those specifications, the requirement for the type of supplies to be used, such as floor waxes. These requirements, while usually considered as separate specifications, would be important if the University were to invite bids on subcontracting custodial maintenance functions.

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TABLE 22

RECOMMENDED FREQUENCY OF SERVICE FOR VARIOUS ITEMS OF SANITATION MAINTENANCE

Item of Sanitation Maintenance	Frequency of Service	
	UNM*	Recommended
Clean Toilet Rooms	Bi-weekly	Daily
Clean Slop Sinks and Drinking Fountains	Bi-weekly	Daily
Wipe Dust from all Window Sills	Bi-weekly	Daily
Dust Horizontal Surfaces of all Furniture and Fixtures, Equipment, Ledges, Woodwork, Doors, and so on.	Bi-weekly	Daily
Sweep Entrance Walkways	Bi-weekly	Daily
Clean Stairwells, Landings, and Elevators	Bi-weekly	Daily
Empty and Clean Ash Trays	Bi-weekly	Daily
Empty Waste Receptacles	Bi-weekly	Daily
Sweep Floors	Bi-weekly	Daily
Clean Floor Mats	Bi-weekly	Daily
Clean Chalkboards	Bi-weekly	Daily
Vacuum Clean Floor Rugs and Carpets	Yearly	Daily
Spot Damp Mop	Monthly	Daily
Touch-up Waxing	As Required	As Required
Dust and/or Vacuum Venetian Blinds and Window Shades	Semi-Annually	Weekly

Item of Sanitation Maintenance	Frequency of Service	
	UNM*	Recommended
Glass Cleaning on Exterior Doors	Semi-annually	Weekly
Spot Cleaning Walls, Doors, and Trim	Yearly	Weekly
Metal Cleaning and Polishing	Monthly	Weekly
Dusting of Heating, Ventilating, and Air Conditioning Equipment	Monthly	Weekly
Vacuum Draperies	Monthly	Weekly
Buff Waxed Floors	Tri-Yearly	Weekly
Damp Mop Floors	Tri-Yearly	Weekly
Scrub Floors and Apply One Coat of Wax	Tri-Yearly	Monthly
Scrub Shower Stalls to Remove Soap Film	Tri-Yearly	Monthly
Wash Waste Receptacles	Tri-Yearly	Monthly
Clean Interior Glass	Yearly	Monthly
Vacuum All Upholstered Furniture or Clean All Plastic Covered Furniture	Never (Dust as required)	Monthly
Clean and Polish Furniture	Never (Dust as required)	Monthly
Clean Light Fixtures	Yearly	Bi-monthly
Take Down and Shake Draperies	Yearly	Bi-monthly
Clean Interior Walls and Ceilings	Every 3 years	Quarterly
High Dusting	Every 3 years	Quarterly

Item of Sanitation Maintenance	Frequency of Service	
	UNM*	Recommended
Carpet Cleaning--Rug Shampooing and Vacuuming	Never	Quarterly
Wash Interior Windows	Yearly	Quarterly
Wash Exterior Windows	Yearly	Yearly
Wash Walls	Seldom	Yearly
Strip Floors and Wax	Tri-Yearly	Yearly
Wash Venetian Blinds	Yearly	Yearly

*Information gathered from an interview with John A. Jacobson, August, 1961.

Note: Within fifteen days after starting work under a contract, a contractor shall submit a schedule for approval showing at what hour and day each of the scheduled items will be ready for inspection.

gets daily service while engineering laboratories receive comparable cleaning yearly.[5]

With this explanation of the specifications in mind, typical minimum performance specifications for sanitation maintenance follow:

Specifications of Minimum Performance

A. Basis of specifications

The following specifications cover the minimum Federal Government performance levels.

B. General Requirements

1. Co-ordination of work

a. Consideration will be expected in the attire of the contractor's employees at all times, in that said attire will be neat and clean as practical in the accomplishment of their duties. Personnel shall wear matching uniforms. (One type and color.)

b. Contractor's employees shall not use recreational equipment or loiter in the buildings being serviced.

c. The names of all contractor personnel will be submitted by roster to include full names, aliases

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[5] Interview with John A. Jacobson, August, 1961.

[illegible]

[illegible]

Specifications of [illegible]

A. Basis of specification

[illegible]

B. [illegible]

1. [illegible]

a. [illegible]

b. [illegible]

c. [illegible]

d. [illegible]

and home address. The roster of names will be furnished the contracting officer immediately upon hiring or designating an employee to perform on a contract.

d. The contractor shall employ only personnel skilled or capable of becoming skilled in the type of work undertaken. The contracting supervisor may require the contractor to dismiss from work such employees as the contracting supervisor deems incompetent, careless, insubordinate, or otherwise objectionable.

e. All employees should be screened by the contractor to assure the University that all employees are of good character and hold a current health certificate limited to a chest X-ray.

f. If the contractor's employees eat their lunches in the buildings, they must do so in areas designated by the contracting supervisor.

2. Superintendence by contractor

a. The contractor shall at all times provide adequate supervision of his employees to ensure complete and satisfactory performance of all work

and [illegible]. The [illegible]

[illegible]

[illegible]

particular [illegible] subject.

4. The [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

5. [illegible]

[illegible]

[illegible]

[illegible]

firmly.

6. If the [illegible]

[illegible]

[illegible]

[illegible]

7. [illegible]

[illegible]

[illegible]

in accordance with the terms of the contract. The contractor, or his competent representative, shall be at the University and available at all times when the work of the contract is being carried out to receive instructions by the contracting supervisor or his representative.

The contractor shall furnish all supplies and equipment for the accomplishment of all work. Contractor's equipment shall be of the size and type suitable for accomplishing the various phases of work described herein, shall operate from existing sources of University furnished electrical power, and shall have a low noise level of operation. Equipment considered by the contracting supervisor to be improper or inadequate for the purpose shall be removed from the job and be replaced with satisfactory equipment. Before commencing the work, the contractor shall submit to the contracting supervisor a list giving the name of manufacturer and brand name of each item of material he proposes to use in accomplishment of the work, together with the manufacturer's certification of compliance with applicable specifications.

Unless otherwise specified, supplies shall be of the highest quality and most suitable type or grade for the respective work under contract. Any item with doubtful flammable or otherwise harmful qualities shall be referred to the contracting supervisor for consideration and shall not be used prior to approval by the contracting supervisor. All other supplies not otherwise approved by the contracting supervisor shall be listed on a chart to be presented for approval.

b. Daily inspection of all the contractor's work will be made by the contracting supervisor's representative. The representative has the authority to point out to the contractor incomplete or defective work and necessary corrective measures, but does not have the authority to alter the terms or conditions of the contract without written authority from the contracting supervisor. No payment shall be made for services which are not performed in accordance with the specifications.

c. The contracting supervisor shall require correction of defective work or damages to any part of the building or its appurtenances when

Unless otherwise specified, supplies shall be of the highest quality and suitable type, made for the purpose for which intended. Any item with doubtful elements or of questionable quality shall be reported to the [illegible] representative for consideration and will not be used prior to approval by the Contracting Engineer. All other questions not otherwise specified by the contracting engineer shall be placed in writing to be submitted for approval.

2. Daily inspections with the contractor's foreman will be made by [illegible] using this Engineer's representative. The representative has the authority to point out to the contractor incomplete or defective work and unsatisfactory conditions, but does not have the authority to alter or change terms or conditions of the contract nor [illegible] authority from the contractor [illegible]. No payment shall be made for [illegible] work and not [illegible] in the same [illegible].

The contractor shall [illegible] written [illegible] of [illegible] the [illegible].

caused by the contractor's employees, equipment, or supplies. The contractor shall place in satisfactory condition all defective work and damages incurred. Upon failure of the contractor to proceed promptly with corrections, the contracting supervisor may withhold any amount necessary to correct all defective work or damages from payment due or to become due to the contractor.

C. Specific services

1. Sanitation maintenance

a. Janitorial Services

1) In addition to the general requirements listed under section B, the following requirements apply specifically to janitorial services.

a) The contractor shall be responsible for closing and locking windows and doors and turning off lights and fans upon completing work in any area.

b) The contractor's employees shall be trained and instructed to report fires, hazardous conditions and items in need of repair such as leaking faucets, plumbing stoppages and other items requiring services

of others. The presence of any vermin such as cockroaches, water bugs, silver fish, mice, rats, and so on shall also be promptly reported and given room number where seen.

c) In case of emergencies such as sudden occurrences of a damaging roof leak or any similar situation, it may be necessary to assemble several janitors at one place to prevent costly damages. Such circumstances will require the contractor to make available to the contracting supervisor any or all janitors on duty at the time. It is understood and agreed that such assembling of janitors relieves the contractor without cost to him of obligation for the services his janitors would have performed.

d) The existing janitorial closets are available for use by the contractor without cost for the purpose of storage of his materials and equipment, excluding inflammable materials. The contractor shall be responsible for the order and cleanliness of these closets.

The University will not be responsible in any way for damage to the contractor's stored supplies, material, or equipment; the material or equipment kept throughout the building in the janitors' closets; or the contractor's employees' personal belongings brought into the building; occasioned by fire, theft, accident, or otherwise.

e) The contractor shall conform to all safety rules and requirements prescribed by the University and the National Safety Council and take such additional precautions as the contracting supervisor may reasonably require for safety and accident prevention purposes. The contractor shall agree to take all reasonable steps and precautions to prevent accident and preserve the life and health of the contractor and University personnel performing or in any way coming into contact with the performance of this contract on such premises. Any violation of such rules and requirements, unless promptly corrected, as directed by the contracting

supervisor, shall be grounds for termination of a contract.

All supplies, equipment and machines shall be kept free of all traffic lanes or other areas where they might be hazardous and shall be secured at the end of each work period in the lockers or other areas provided for this purpose. Cloths, mops, or brushes containing a residue of wax or other combustible material subject to spontaneous ignition shall be disposed of each day at the completion of work. Cleaning solutions shall be disposed of in plumbing fixtures provided for this purpose. Appropriate warning signs shall be provided for slippery floor areas caused by cleaning or waxing operations.

f) Contractor's employees shall be required to interrupt their work at any time to allow passage of personnel.

2) The following items not only define a particular service need, but also specify the minimum standard of performance allowable in fulfilling the service need and finally describe the scope of each task.

a) Sweeping includes brush or mop sweeping using sweeping compound, if required, or mechanical brush-vacuum sweeping, without damage or disfigurement of furniture, doors, or base trim.

A properly swept floor is free of all dirt, dust, grit, lint, and debris except imbedded dirt and grit. No dust streaks should be evident nor dust left where dirt is picked up by floor maintenance or with a dust pan. No dirt shall be left in corners, under furniture, or behind doors. Sweeping by the fashion selected shall raise very little dust or debris and be accomplished in such a manner as to minimize spread of dust into the air.

All tile, wood, or concrete floors, stairways, landings, and stoops shall be swept, using an approved sweeping compound, and dust and debris shall be removed to receptacles provided for this purpose outside the building. Carpeting shall be vacuumed and the dirt and debris removed to the

a) [illegible]

during [illegible]

[illegible]

damage or [illegible]

or [illegible].

A [illegible]

dirt, sand, grit, lint, and [illegible]

[illegible]

should be [illegible]

is picked up by [illegible] with a

[illegible] pen. [illegible]

under [illegible]

up the [illegible] small [illegible]

little [illegible]

such a [illegible]

[illegible].

All [illegible]

[illegible]

[illegible]

and [illegible]

[illegible]

the [illegible]

[illegible]

receptacles provided. All furniture shall be replaced to its original position on completion of sweeping. Spots shall be removed from rugs as they appear using "host" dry cleaning method or dry suds method.

b) Floor scrubbing is the cleaning of floors by the use of deck brushes, cylinderical or disc type machines; or automatic machine scrubber and detergent solution, using as small amount of water as possible, followed by a plain water rinse and pick-up immediately after the scrubbing process.

Scrubbing is satisfactorily performed when all surfaces are without imbedded dirt, cleaning solution, film, debris, stains and marks, and standing water, and all areas and floors have a uniformly clean appearance.

c) Damp mopping is the cleaning of floor surfaces using cotton or sponge yarn mops, appropriate stain removal agents, unheated water, and detergent if required, using as small amount of water as possible.

A satisfactory damp-mopped floor is without dirt and dust, marks, film, streaks, debris, and standing water.

All waxed and unwaxed resilient floors, terrazzo, quarry tile, and concrete floors, including stairs and landings shall be damp-mopped. All waxed and terrazzo floors shall be buffed. Resilient waxed floors which include all linoleum, plastic, asphalt, rubber, and cork floors, may be dry-cleaned provided satisfactory results are demonstrated by the contractor. Floor dry-cleaning is the cleaning to remove marks, imbedded dirt, and debris by buffing with steel-wool disc or drum on a machine having vacuum soil pick-up. Accessible sealed and waxed wood floors shall be dry cleaned. Machines shall be run with the grain on strip floors and diagonally on wood block flooring. Sealed and waxed floors, not accessible with the dry cleaning machine shall be damp-mopped using as little water as possible. In no case shall water be allowed to stand on these floors or seep into the joints.

Damp-mopped floors shall be buffed with palmetto brushes. Floors shall be rinsed clean with clear water. Floors shall be dried after rinsing to prevent any standing water from being absorbed by the floor material, seeping into seam of floor material, seeping into seam of floor coverings, or being left under filing cabinets and so on. Mop water splashed on baseboards, doors, furniture, equipment, and so on shall be removed immediately. Special care shall be used in mopping stairs to prevent water from dripping over ends of treads onto wall surfaces. Walls will be cleaned immediately if any dripping occurs.

d) Spot mopping shall include the removal of stains caused by spillage on small areas of the floor surfaces and also where windows and doors are left open and rain, snow and sleet blows in. Mud or dirt spot mopping shall be performed in the same manner as specified in the damp mopping section.

A surface adequately spot cleaned is free of all stains, deposits, and is substantially free of cleaning marks.

e) Wax removal or stripping is the removal of all wax down to the flooring material, using compounds especially prepared for this purpose, with brush or steel-wool agitation as required, following by rinsing with plain water to remove all wax, solution, dirt, and film.

Wax removal is accomplished when surfaces have <u>all</u> wax removed down to the flooring materials; the floor is to be left free of all dirt, stains, deposits, debris, cleaning solution and standing water and the floor has a uniform appearance when dry. Plain water rinse and pick-up must follow wax removal immediately.

f) Primary waxing is the application of two coats of water-emulsion wax with clean applicator or two coats of liquid or paste spirit type wax over the entire floor after wax removal as above, with thorough buffing after each coat.

A properly waxed floor has a thin, even coating with no heavy accumulations of wax

3) The removal of [illegible] to the [illegible]
of wall was down to the [illegible],
using compounds carefully prepared for this
purpose, with cloth or absorbent materials
as required, followed by rinsing with clean
water to remove all dirt, solution, and/or
film.

The removal is not completed when surfaces
have all been brought down to the original,
satisfactory condition and to be fully free of
all dirt, stains, deposits, marks, cleaning
solution and other foreign matter and there be
a uniform appearance over all. When all stains
and marks have been removed, [illegible]
immediately.

2) Primary spray is a cold application of two
coats of water-repellent solution with airless
application of two coats of [illegible] or [illegible]
[illegible] type [illegible] [illegible] after
are [illegible] as above, [illegible] experimental
[illegible] test made.

A [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]

along walls or fixtures which have discolored or accumulated to objectional depths. The wax should be buffed to a uniform sheen with no brush marks. The condition of a safe, non-slip surface shall be adhered to in all cases.

Primary wax resilient, and oxycholoride cement floors shall include wax removal as outlined previously. No buffing shall be performed until after drying. No wax shall be applied to the floor in an area approximately six inches from walls, filing cases, and so on. These areas shall be covered by the wax carried by the buffing machine from the adjacent areas.

g) Touch-up waxing is the application of wax in heavy traffic areas between primary waxing. This includes a thorough damp mop cleaning of the entire waxed area prior to application of wax and buffing entire area after the application of wax. The standards of appearance set forth in the primary waxing section apply here also.

Touch-up waxing and buffing shall be done after damp mopping all waxed resilient flooring

in entrances, lobbies, corridors, and all other heavy traffic areas as directed by the contracting supervisor.

h) All waxed areas are buffed sufficiently for maximum gloss, removal of surface dirt, and have a uniform appearance. All wall surfaces and equipment will be cleaned of all marks and materials deposited thereon by floor cleaning methods immediately after buffing.

i) A properly dusted surface is free of all dirt and dust, dust streaks, lint and cobwebs, with no oily streaks left by dusters. Glass in cabinets, desk tops, or picture frames shall be free from oily film left by dusters. No condition of obvious or existing dust shall be permitted in any room or corridor area within contract area.

j) When cleaning stairways, landings and elevators, surfaces shall be swept and all lint, dust, dirt, and debris removed. All crevices shall be free of dust, dirt, debris,

and lint. Stains and marks shall be removed with a damp rag and scouring powder.

k) Slats or venetian blinds will be cleaned by using a soft sponge dampened in a mild soap solution. Care must be taken to avoid wetting the webbing straps. Straps must be dry-cleaned or renewed.

l) Tarnishable metal and hardware shall be polished using approved polishing compound, and burnished with a clean cloth. Nickel or stainless steel may be washed with a neutral soap solution and wiped dry with a clean cloth.

m) All mirrors, glass cases, desk tops, and glass at building entrances shall be cleaned using plain water or cleaning solution prepared for this purpose. Adjacent trim shall be wiped clean with a damp cloth. Scouring powder or ammonia shall not be used. Glass is clean when all accessible glass surfaces are without streaks, film, deposits, and stains, and has a uniformly bright appearance and adjacent surfaces have been wiped clean.

n) All accessible components or light fixtures

[illegible]
without dropping and scattering powder,
b) [illegible]
[illegible]
[illegible]
[illegible]
disintegrated or crushed.
[illegible]

including bulbs and tubes shall be dusted with a cloth or yarn duster. Fixtures shall not be cleaned with a damp cloth.

o) Interior surfaces of all windows will be washed monthly. Exterior surfaces will be washed at least every three months. Cleaning of exterior surfaces will be scheduled to coincide with monthly cleaning of interior surfaces. Windows will be cleaned both inside and outside without opening in all air conditioned buildings. It will be necessary to use stepladders on the inside and extension ladders and safety belts on the outside. All outside window washers <u>must</u> use safety belts at all times. Inside window washers may not stand or step on window sills, radiators or any other permanently installed equipment at any time. Outside workers may stand on window sills, removing all blemishes to the building upon completion. To be included as a part of window washing is removal of all foreign surfaces from the glass including paint, removal of all dirt, debris and cobwebs from window frames and sills. All

windows in a single room will be completed both inside and outside the same day the first window in that particular room is started.

Glass is clean when all accessible glass surfaces are without streaks, film, deposits, and stains, and has a uniformly bright appearance and adjacent surfaces have been wiped clean. When cleaning exterior windows, the contractor shall also hose clean window screens. Window screens shall be dry and clean before reinstallation.

p) All waste receptacles shall be emptied and trash and paper from the buildings removed and deposited in collection facilities provided for this purpose.

q) All waste receptacles shall be washed to be kept in a sanitary condition. Washing shall be accomplished with a brush and detergent solution. Use of steam or cleaning harmful to paint or receptacle material will not be permitted. Receptacles shall be left free of deposits, dirt, streaks and odors.

r) Emptying and cleaning ashtrays and urns includes emptying all ash trays and wiping clean with a cloth; cleaning all sand urns and replacing sand as provided when required. The waste from ash trays and urns shall be emptied into metal containers and removed to the outside collection facilities provided for this purpose. Sand shall be changed in urns or sifted weekly, at the discretion of the contracting supervisor.

s) When not otherwise washed, all interior painted wall, partition, and ceiling surfaces and window trim, except acoustical material, should be cleaned. Beginning at the highest point, exposed overhead pipes and equipment shall be dusted with untreated dusters or by vacuuming. Cobwebs shall be removed with an upward stroke to avoid streaking.

t) Machine or hand methods may be used for wall washing. In either case, a uniform clean surface will result. A detergent solution of the weakest strength sufficient to do the job will be used, thereby injuring the paint as little as possible. To be included are all

wall surfaces from floor to ceiling such as structural tile, plastic, plaster, and so on. The contractor must inform the contracting supervisor before washing any walls which might be damaged by such action, and await his decision before proceding. The contractor will be responsible for any wall damage incurred.

After cleaning, the surfaces of all walls, ceiling, exposed pipes, and equipment will have a uniformly clean appearance, free from dirt, stains, streaks, lint, and cleaning marks. Painted surfaces must not be unduly damaged. Hard finished wainscots or glazed ceramic tile surfaces must be bright, free of film, streaks, and deposits.

u) All the tile or impervious finish wainscots, and toilet stall partitions and doors shall be cleaned. Cleaning shall be accomplished with a detergent solution and sponge followed by a plain water rinse and drying with a clean cloth. Abrasive cleaners shall not be used on painted or resilient surfaces. All spillage

Sweeping compound will be used at all times for sweeping asphalt tile floors. Shower walls shall be wiped dry and the floor cleaned. Waste receptacles shall be emptied. All trash and paper will be removed from the building and deposited in a trash container. All waste receptacles shall be washed, cleaned, and serviced as needed prior to return to original location. Deodorants shall not be used except when specifically directed by the contracting supervisor. Objectionable odors will be prevented by proper cleaning and disinfecting. All supplies, including toilet tissue, hand towels, and hand soap shall be replenished and placed in appropriate receptacles as provided.

x) All items shall be cleaned using detergent or scouring powder if required. Cabinets of water chillers shall be wiped clean with a damp cloth. Any spillage on floors or walls adjacent to a fixture shall be wiped clean with a damp cloth.

y) All upholstered surfaces shall be vacuumed to remove dust and lint.

z) Wood and finished metal surfaces shall receive furniture polish with rubbing as necessary for cleaning followed by polishing with a clean dry cloth or electric buffer. Leather coverings shall be thoroughly cleaned with a combination cleaner and polish to be approved by the contracting supervisor, followed by polishing with a clean dry cloth. When cleaned or polished, all surfaces shall be of uniform appearance, free of deposits, streaks, or film. All spillage shall be wiped clean with a damp cloth.

aa) Draperies shall be cleaned by vacuum once weekly and shall be removed and shaken clean every two months. Removing and replacing of drapes shall be done in such a manner as to prevent tearing.

bb) Carpeting will be shampooed according to specifications given by the manufacturer.

cc) Entrance floor mats shall be cleaned of dirt and dust daily.

dd) Burned out lights in areas serviced are

to be reported to representatives designated by the contracting supervisor. Incandescent and fluorescent lights will be furnished and replaced by the University.

ee) Slate surfaces shall be washed with clean water and cloth; the chalk tray shall be washed and dried. No chalkboards should be washed where request is made to save written notice or material. Important! No composition painted blackboard should be washed. A treated "chalk-off" cloth or its equal should be used. A treated cloth may be used for all boards with permission of the contracting supervisor. Board erasers shall be cleaned by a vacuum cleaner to remove chalk dust.

ff) Bowling alleys consist of fourteen alleys located in the New Mexico Union. Frequency of clean-up will be as directed by the contracting supervisor. During the period of September through April, the bowling alleys will be cleaned daily. During the period of May through August, the bowling alleys will be cleaned approximately two days per week.

[illegible]

(e) [illegible]

(f) [illegible]

Payment for this service will be on a per clean-up basis.

Services will be rendered in accordance with specifications listed below and as recommended by the National Bowling Council in pamphlet entitled "Bowling Alley Maintenance Standard", 1957 edition:

1. Cleaning and dressing lanes with Brunswick Mineralastic dressing "x" and buffing lanes with burlap.
2. Cleaning rubber pit mats and kickbacks with cloth, weak ammonia and water solution, and fine steel wool if necessary.
3. Cleaning cushion facing with a cloth and soapy water solution.
4. Vacuuming pits.
5. Thorough dusting of ball return track from newal post to pit using fine steel wool if necessary.
6. Dust mopping gutters.
7. Cleaning approaches with Brunswick Approach Spot Cleaner using a cloth and fine steel wool when required.

8. Buffing approaches with fine steel wool when required.

9. Dusting and cleaning spectators seats and scoring equipment.

10. Wiping the pin decks with a cloth dampened with Brunswick and Mineralastic Dressing "x".

gg) Snow and/or ice from sidewalks leading to the entrance of buildings and from automobile parking lots to sidewalks shall be removed. If reasonably possible, these areas shall be clear by the time employees arrive for work or students begin classes. (Estimated three times a year maximum.)

b. Garbage and trash collection

1) The following definitions will apply to the specifications for garbage and trash collections.

a) Garbage consists of animal and vegetable waste resulting from handling, preparation, cooking and consumption of food.

b) Trash consists of paper boxes, glass, tin cans, wasted materials from construction, tree and shrubbery limbs, broken concrete, and so on.

c) A container is any type of can or box with or without a lid used to retain trash or garbage.

2) The following services will be required from any contractor in connection with proper trash and garbage disposal.

a) Garbage and trash containers will be furnished and maintained by the University. The contractor will be responsible for damages to the garbage containers which will be returned to their original condition in the event of damage by the contractor. All waste receptacles shall be washed, cleaned, and/or serviced as needed prior to return to their original location.

b) All equipment necessary for the operation of garbage and trash collection and protection and safety of personnel, such as standard packer trucks, shovels, pitch forks, brooms, machetes, gloves, goggles, and required safety equipment shall be furnished by the contractor. The contractor shall have vehicles covered with insurance as required by the contractor supervisor.

c) The contractor shall provide enough personnel to efficiently maintain the standards

] The following services will be required of any contractor in connection with garbage and garbage disposal.

4) Garbage and trash containers will be furnished and maintained by the University. The contractor will be responsible for damage to the University containers which may be attributed to a lack of reasonable care in the course of usage by the contractor. All containers shall be washed, cleaned, and/or serviced as needed prior to return to their original location.

5) All equipment necessary for the operation of garbage and trash collection and processing and safety of personnel, such as standard [illegible] trucks, [illegible], brooms, shovels, gloves, goggles, and required safety equipment shall be furnished by the contractor. The contractor shall have [illegible] [illegible] as required by [illegible] [illegible].

6) The contractor shall [illegible] [illegible] [illegible]

of operation outlined in the method of collection and records section.

d) Each truck driver must possess a valid operator's permit. Drivers must be thoroughly acquainted and comply with state, city, and University traffic regulations.

e) The contractor must keep accurate operating records for each collection truck, noting the size of each load. The contractor collects and compiles the reports, converting size of loads to cubic yards and submits a monthly report to the contracting supervisor.

f) The contractor shall keep up-to-date maps showing location of pick-up stations, and collection and disposal routes. Copies of University lay-out maps shall be furnished to the contractor by the University on request.

g) The contractor will require each vehicle or piece of equipment operating on the University to pass the required state safety check. Each vehicle or piece of equipment will carry a current New Mexico safety decal in a readily visible place.

3) Method of collecting garbage and trash.

a) The garbage and trash collection methods outlined hereinafter for the different conditions and requirements are preferred by the University; nevertheless, the contractor may submit for the approval of the contracting supervisor other methods or combinations thereof which, in the opinion of the contractor and in compliance with the requirements outlined for each condition, improve the efficiency of the collection system.

(1) Pick-up stations are designated locations within the area where garbage and trash is assembled and stored for collection. Location of the presently required pick-up stations may be obtained from the University.

(2) Collection of garbage and trash shall be performed two times weekly. Garbage and trash collection shall be performed on holidays, if the holiday falls on a regularly scheduled collection day. Compaction and/or packer type garbage collection trucks shall

be used to perform the collection to prevent escapage of odors or spilling or scattering of garbage by the wind. Garbage and trash shall be carried from the grounds or buildings premises where the garbage and trash is regularly kept to the collection vehicle.

b) Garbage and trash collectors and loaders shall be careful not to spill garbage and trash during collection and transient operations. Any garbage and trash spilled shall be immediately collected and the area thoroughly cleaned.

c) Garbage and trash shall be disposed of in either the city or county dump as specified by the contracting supervisor.

d) The inside of collection trucks and containers shall be thoroughly cleaned and deodorized prior to the start of each collection operation. Contractor equipment and vehicles may be periodically inspected by University medical and/or safety personnel to insure compliance with sanitary and safety directives. Cleaning and deodorizing of containers are the responsibility of the janitorial staff.

e) The contractor shall exercise extreme care in the protection of trees, shrubs, and landscaped areas during collection operations, and shall restore to its original condition any areas or facility damaged by his personnel or equipment.

c. Landscaping and grounds maintenance

1) The lawns shall be maintained as follows:

a) Mowing shall be accomplished by the use of power mowers of either rotary or reel type with mulching attachments and with blade height attachments. During the dormant season from October 1 to April 1, mowing shall be accomplished periodically and as often as necessary to keep the grass between 1 and 2 1/2 inches in height and to discourage weed growth. Grass shall never be mowed to a height of less than 1 inch during the dormant season. During the growth season of approximately April 1 to October 1, the lawns shall be mowed at intervals of approximately one week; or as often as required to keep the grass between 1 and 2 inches in height. Mower blades shall be

c) The contractor shall use extreme care in the protection of trees, shrubs, landscaped areas and [illegible] operations, and shall restore to its original condition any area or facility damaged by his operations or equipment.

9. Maintaining and Protecting Grass Areas

1) The lawns shall be maintained as follows:

a) Lawns shall be mowed regularly, the use of power mowers of rotary [illegible] type with mulching attachments and with blade height adjustment. During the growing season from October 1 to April 1, mowing shall be accomplished periodically, at a rate as necessary to keep the grass between 1 inch and 2 1/2 inches in height and [illegible] growth. Grass shall never be cut to a height greater than 1 inch [illegible] during the growing [illegible]. From April 1 to October 1, the lawn shall be mowed at intervals of not to exceed [illegible] [illegible] and 2 inches [illegible]

[illegible]

adjusted so that the grass is never cut to a height of less than 1 inch during the growth season.

b) The lawns shall be edged adjacent to the pavements, walkways, walls, and shrubbery areas. Edging shall be accomplished at a frequency of one-half that of mowing; and shall be done in conjunction with the mowing operation. The cut shall be straight and the area from which the grass is removed shall be approximately one inch wide. All grass stolens and rhizones shall be removed, but care shall be exercised to keep all the soil in place. The removed grass shall be deposited in the area provided.

c) The lawns shall be watered thoroughly at least twice a week to insure that the soil is moist at all times. This requirement may be by-passed in unusually wet weather. Water shall be applied at a uniform rate and in such a way that the entire lawn area has a sufficient amount to penetrate at least two inches. It shall be the responsibility of the contractor to ascertain the condition at all times and maintain the

adjusted so that the grass is never allowed to [illegible] a height of more than [illegible] inch during the growing season.

b) The grass shall be mowed [illegible] to the [illegible], [illegible], and [illegible] shall be [illegible] a [illegible] one-half inch of growth; [illegible] with the mowing [illegible] cut shall be [illegible] the grass is however [illegible] inch mark. All grass clippings [illegible] shall be removed, [illegible] to keep all [illegible] in place. The removed grass shall be deposited in the [illegible].

c) The plots shall be [illegible] at all times. [illegible] be applied at a uniform rate [illegible]

moisture content. The University will supply the water at no expense to the contractor; however, the contractor will furnish all hose, sprinklers, and attachments necessary to supplement the University's underground sprinkler system. Water shall be applied uniformly by sprinkler method and shall never be applied at a rate that might erode the grassed surfaces.

d) When undesirable growth appears in the lawns, it shall be destroyed. No growth shall be allowed to mature to a point that it can reseed itself. All other growth except lawn grass shall be destroyed. The use of chemical weed killers will not be permitted. Undesirable growth shall be removed in its entirety, including root systems, and destroyed.

e) The lawns shall have two applications of fertilizer per year, with one application made in September and the other in March. Each application shall be uniformly spread by machine method at a rate of not less than twenty-five pounds per 1000 square feet; and

[illegible] development. The University will [illegible]

[illegible] which are not [illegible]

lower-grade [illegible] will function in the

[illegible], and [illegible] to

[illegible] the University's [illegible]

[illegible]

[illegible]

be [illegible]

planned program.

[illegible]

town, it would be [illegible]

not allowed [illegible]

[illegible]

[illegible] shall be [illegible]

and [illegible] will not be [illegible]

[illegible] shall be [illegible]

[illegible] systems, and [illegible].

2. The [illegible] shall [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

the fertilized areas shall be sprinkled as soon as possible to insure penetration of the fertilizer into the soil. Fertilizer shall be a commercial fertilizer with at least 50% organic base, and the remainder made up of soluble compounds composed of ten parts nitrates, six parts phosphates, and four parts potash. The potash content could be lower if a check of the soil composition shows that the potash addition would be unnecessary

f) When evidence of the presence of insection and fungi appears, the contractor shall take immediate steps to treat the affected areas with approved insecticides. Insecticides and application methods shall be in strict accordance with the recommendations of the local Agricultural County Agent. It shall be the responsibility of the contractor and the representative of the contracting supervisor to determine when the insecticide treatment is required.

2) The shrubbery and flowers shall be maintained and cared for in a manner similar to that specified for lawns and as follows:

a) The beds shall be kept free of undesirable growth at all times, including runners from the lawn grass; and the boundaries of the beds shall be kept trimmed to a neat line.

b) The soil shall be kept moist at all times.

c) The beds shall be covered with an approved mulch consisting of hay, leaf mold, or peat, or a combination thereof.

d) The beds shall be fertilized as specified for lawns except that the fertilizer shall be 100% organic fertilizer.

e) The shrubs shall be kept neatly trimmed, and diseased and dead portions shall be completely removed. All trimmings shall be removed from the site and destroyed.

f) All shrubs shall be sprayed, as required, with an approved insecticide to adequately control insect infestation at all times.

a) The sod shall be kept free of unhealthy growth at all times, including weeds from the lawn grades and the boundaries of the lawns shall be kept trimmed to a neat line.

b) The soil shall be kept moist at all times.

c) The lawn shall be covered with an approved mulch consisting of hay, leaf mold, or peat or a combination thereof.

d) The lawn shall be fertilized as necessary for lawn growth that the fertilizer shall be 100% organic fertilizer.

e) The mulch shall be kept neatly trimmed and dished and at a position shall be completely removed. All trimmings shall be removed from the site and disposed of.

f) All shrubs shall be sprayed, as required, with an approved insecticide as necessary until a survey inspection at its time.

APPENDIX II

Dear Sir:

At the present time I am writing a thesis on the Buildings and Grounds Department of the University of New Mexico. In order to compare our department with others throughout the country, I would appreciate some of your time in filling out the enclosed questionaire. This questionaire is to supplement one sent out by Mr. Sam F. Brewster, Director Department of Physical Plant, Brigham Young University, as I am using data which he compiled as a base of reference.

I realize that this is a very busy time of the year for you with "spring housecleaning" approaching; therefore, any information not readily obtainable, please estimate or omit to avoid delay in returning this questionaire.

Please return this in the attached envelope by 30 June 1961. Thank you for your help in this matter.

Yours truly,

Raymond P. Lutz

Raymond P. Lutz
Instructor University of New Mexico

QUESTIONAIRE

Questions of interest Concerning Administration of Buildings and Grounds Departments at Representative Universities.

For: Thesis of Raymond P. Lutz, University of New Mexico.

A. Your School

1. Name and address____

2. Enrollment, Fall 1960____

3. Campus areas--acres

   a. Total area________________

   b. Area intensively maintained______________

4. Campus buildings--square feet

   a. Total floor area________________

   b. Primarily academic______________

   c. Dormitories____________________

   k d. Football stadium________________

   e. All food facilities_____________

   f. Buildings and grounds department facilities______________

   g. Temporary building area_________

B. Your Personnel

1. Supervisors title____

2. Supervisor reports to____

3. Number of workers____

4. Unionization of workers:_______None, _____Some, _____All

5. Working days per week____

6. Working hours per week____

7. Form of job instructions: _____Oral, _____Written,_____Both

C. Your Plant Facilities and Department

1. Condition of shop facilities

QUESTIONAIRE

Questions of Interest Concerning Administration of Buildings and Grounds Departments at Representative Universities.

For: Thesis of Raymond P. Lutz, University of New Mexico.

A. Your School

1. Name and address________________________________

2. Enrollment, Fall 1960__________________________

3. Campus areas-acres

a. Total area____________

b. Area intensively maintained____________

4. Campus buildings-square feet

a. Total floor area____________

b. Primarily academic____________

c. Dormitories____________

x d. Football stadium____________

e. All food facilities____________

f. Buildings and grounds department facilities____________

g. Temporary building area____________

B. Your Personnel

1. Supervisory title________________________

2. Supervisor reports to________________________

3. Number of workers________________________

4. Distribution of workers: ____ Men, ____ Women, ____ All

5. Normal days per week________________________

6. Working hours per week________________________

7. Form of job instruction: ____ Oral ____ Written ____ Both

C. Your Plant Facilities and Equipment

Condition of [illegible]

2. Pieces of heavy equipment______________________
(e. g., construction or shop equipment)

3. Do you have a motor pool?______________________

4. Pieces of Automotive equipment______________________

5. Budget allotted to Buildings and Grounds______________________

a. Percent of educational budget______________________

b. Percent of educational budget desired______________________

c. Percent of allotted budget committed at time of receipt___

D. Your Methods

1. Volume of total work done by outside contractors--percent

a. Maintenance work (e.g., custodial, painting, window washings)______________________

b. Operations work (e.g., laundry, heating plant, garbage disposal)______________________

c. Minor repairs and alterations--$1,000 or less______________

d. Major repairs and alterations______________________

e. Building construction--$50,000 or less______________

f. Building construction--$50,000 to $250,000______________

g. Building construction--$250,000 and up______________

2. Do departments other than the Buildings and Grounds Department have responsibility for maintenance and operations work?_____

3. Which departments do this work?

4. Is there some form of Campus Planning Committee at your school?______________________

5. Is there a Planning Section in your Buildings and Grounds Department?______________________

6. Campus Master Plan

a. Is one in existence?______________

b. Is it followed closely for location of buildings and facilities?______________

c. Is it adequate in the foreseeable future?__________

7. Average number of people employed as planners______________

8. Group responsible for the following planning functions:

a. Preparation of plans and specifications of new major buildings

b. Planning details and programming requirements of new major buildings

c. Plans for remodeling existing buildings

d. Preparation of plans and specifications for extensions to outside utilities

e. Landscaping plans

f. Detailed inspection of major construction projects

Job Description	3000 to 3600	3600 to 4200	4200 to 4800	4800 to 5400	5400 to 6000	6000 to 6600	6600 to 7200	7200 to 8000	8000 to 10,000	10,000 to 12,000	12,000 to 14,000	14,000 to 16,000	16,000 and up
Chief Physical Plant Administrator													
Ass't Administrator													
Principal Planner													
Principal Construction Engineer													
Chief Air Conditioning Engineer													
Chief Heating Plant Engineer													
Chief Security Officer													
Chief Auto Mechanic													
Locksmith													
Electrical Foreman													
Mechanical Foreman													
Carpenter Foreman													
Custodial Foreman													
Landscape Foreman													
Paint Foreman													
Labor Foreman													

8. Hourly Wage Paid to Employees (Check One)

Job Description	0.50 to 0.75	0.75 to 1.00	1.00 to 1.50	1.50 to 2.00	2.00 to 2.50	2.50 to 3.00	3.00 to 3.50	3.50 to 4.00	4.00 to 4.50	4.50 to 5.00	5.00 to 5.50	5.50 to 6.00	6.00 to 6.50

Job Description	0.50 to 0.75	0.75 to 1.00	1.00 to 1.50	1.50 to 2.00	2.00 to 2.50	2.50 to 3.00	3.00 to 3.50	3.50 to 4.00	4.00 to 4.50	4.50 to 5.00	5.00 to 5.50	5.50 to 6.00	6.00 to 6.50
Skilled Carpenters													
Skilled Electricians													
Skilled Plumbers													
Skilled Painters													
Skilled Gardeners													
Skilled Labor													
Full Time Common Labor													
Part Time Common Labor													
Student Help													

9. Average Number of Employees in Various Job Categories

Job Category	FullTime		Part Time	
	Student	Other	Student	Other
ustodial				
efuse Disposal				
andscape Maintenance				
est Control				
ampus Mail				
eneral Trucking				
echanical Repairs				
ir Conditioning and Ventilation				
efrigeration				
heet Metal				
eating				
lumbing				
utomotive Repair				
otor Pool				
ocksmith Work				
eys				
ampus Police				
ight Watchman				
ire Prevention and Control				
oom Scheduling				
lectrical				
ampus Phones				
ffice Machine Repair				
ainting				
arpentry				
abinet Work				

Job Category	Full Time		Part Time	
	Student	Other	Student	Other
niture Repair				
olstery				
ndry				
eral Stores				
Others				

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

goes through a meter and then is distributed throughout the campus for laboratory use, the Home Economics Department, and heating the buildings which are not connected to the steam lines from the heating plant. The cost of this gas is 43 cents per 1,000 cubic feet.[3]

The majority of the gas entering the campus goes through a metering manifold and then is consumed by the boilers in the heating plant. This fuel is purchased for 33 cents per 1,000 cubic feet.[4] This rate is known as the "dump rate." Originally it was used to entice utilities to burn natural gas during periods of low residential demand. This rate is still available to large commercial users on the condition that the "dump rate" users "get off the line" immediately after notification from the gas company. The "dump rate" customers must continue to use an auxiliary fuel until further notification. This situation usually arises only on rare occasions, such as a break in the gas transmission line or periods of unusually high residential demand. The 23 percent reduction in fuel costs makes "dump rate" gas quite attractive, especially considering the few times it is necessary for the University to go on "stand-by."[5] However,

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[3]Interview with John A. Jacobson, May, 1961.

[4]Ibid.

[5]Interview with Prof. A. D. Ford, May, 1961.

gone through a meter and then is distributed throughout the campus for laboratory use, [illegible]. [illegible] heating the buildings [illegible] lines from the heating plant. The cost of this gas is [illegible] cents per 1,000 cubic feet.[illegible]

The majority of the gas [illegible] a metering manifold and then is [illegible] the heating plant. This gas is purchased at [illegible] 1,000 cubic feet. This rate is known as the "dump" rate. Originally it was used to enable utilities to [illegible] gas during periods of low residential demand. This rate is still available to large consumers, such as the university, [illegible] that the [illegible] the line [illegible] often notification from the gas company. The [illegible] contract [illegible] further notification. This [illegible] on cold [illegible], such as a [illegible] line or periods of unusually high residential demand [illegible] 22 percent [illegible] in [illegible] quite [illegible], [illegible]

[illegible]

[illegible]

small boilers and furnaces are not constructed to utilize two fuels on an immediate substitution basis. Also, Southern Union Gas Company has set a minimum limit on the size of boiler which the company will allow to be on a "dump rate." This limit the University's boilers just exceed.[6]

Smaller boilers are also less efficient than larger boilers. The efficiency of the boilers now in the heating plant is 77.8 percent. The efficiency of the conversion of chemical energy in the fuel to heat energy output is 91 percent.[7] A comparable figure for maximum heat input to output ratios for a unit of the size required for individual campus buildings is 53 percent.[8] Since approximately the same amount of heat would be required in the buildings, neglecting the heat loss in the present distribution system, 17.15 percent more gas would be necessary to heat the buildings. For this analysis it is assumed that the cost of the heating plant and distribution system would equal the cost of individual heating systems. Experiences in the field of plant engineering show this assumption to be somewhat unfair to the heating plant.

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[6]Ibid.

[7]Author's performance test, January 7, 1958. This test may be found on page 180.

[8]W. H. Severns and J. R. Fellows, Air Conditioning and Refrigeration (John Wiley and Sons, Inc.: New York, 1958), p. 179.

small boilers and furnaces are not economical to utilize two shifts on an immediate substitution basis. Also, Southern Union Gas Company has set a minimum limit on the size of boiler which the company will allow to be on an "dump rate." This limit the University's boilers just exceed.[4]

Smaller boilers are also less efficient than larger boilers. The efficiency of the boilers now in the heating plant is 77.8 percent. The efficiency of the conversion of chemical energy in the coal to heat energy is about 65 percent.[5] A comparable figure for various heat input to output ratios for a unit of the size required for individual campus buildings is 65 percent.[6] Since approximately the same amount of heat would be required in the buildings, neglecting the heat loss in the present distribution system, 17.13 percent more gas would be necessary to heat the buildings. For this analysis it is assumed that the cost of the heating plant and distribution system would equal the cost of individual heating systems. Experience in the field of plant engineering [illegible]

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[4] Ibid.

[5] [illegible]

[6] [illegible]

The University obtains, processes, and distributes water from its own wells at a cost of 8 cents per 1,000 gallons.[9] The rate charged by the City of Albuquerque for customers with large usage requirements is 17 cents per 1,000 gallons.[10] The demand for water delivered to the campus for the calendar year of 1957 was 353,410,000 gallons.[11] This water would cost over twice as much if it were purchased from the city.

Finally the chilled water for the campus air conditioning units is produced by a 600 ton Carrier centrifugal compressor coupled to a Westinghouse Steam Turbine. Since steam is required on the campus the entire year for various reasons, such as dormitory cooking, the steam driven compressor and chilled water system seemed to be a logical choice. This refrigeration unit produces 760 tons of capacity with a steam rate of 10.1 pounds per ton. A ton of refrigeration is equal to a heat removal rate of 12,000 Btu per hour. The following calculation shows the approximate cost of operating this unit for a typical year, assuming an operating time of 439 hours per year, and a heat content for natural gas at this altitude of 860 Btu per cubic foot.[12]

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[9] Interview with John A. Jacobson, May, 1961.

[10] Ibid.

[11] Interview with Prof. A. D. Ford, May, 1961.

[12] Ibid.

[illegible] the industry generally, however, [illegible]

[illegible]

[illegible]

[illegible]

The demand for water [illegible] by the [illegible]

year of 1953 was 151,000,000 gallons.[illegible] [illegible]

over twice as much as it [illegible].

Similarly [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

to a heat [illegible] of 12,000 [illegible] per [illegible].

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

$$\text{Cost per year} = 600 \text{ tons} \times 10.1 \frac{\text{lb. steam}}{\text{ton}} \times 1101 \frac{\text{Btu}}{\text{lb. steam}} \times$$

$$\frac{1 \text{ ft.}^3 \text{gas}}{860 \text{ Btu}} \times 0.33 \frac{\$}{\text{ft.}^3} \times 439 \frac{\text{hrs.}}{\text{yr.}} \times \frac{1}{.778}$$

$$= \$1435.00 \text{ per year.}$$

In contrast to this, if individual reciprocating compressors were used with electric motors, the cost would be considerably greater. The efficiency of a reciprocating compressor is 70 percent.[13] The efficiency of a large electric motor is 88 percent.[14] Therefore, the yearly operating cost of individual units would be:

$$\text{Cost per year} = 600 \text{ tons} \times 12{,}000 \frac{\text{Btu/hr}}{\text{ton}} \times \frac{1 \text{ hp}}{2545 \text{ Btu/hr}} \times$$

$$\frac{0.7455 \text{ kw}}{1 \text{ hp}} \times \frac{0.015\$}{\text{kw-hr}} \times 439 \frac{\text{hrs.}}{\text{yr.}}$$

$$= \$22{,}600.00 \text{ per year.}$$

In summary, then, there is an appreciable yearly savings to the University through the heating plant operation. The services supplied by the heating plant would cost approximately $95,881 per year more if purchased for separate units in individual buildings on the campus.

Below are found comparative costs of utility services. The 1960 operational costs of the heating plant were as follows:[15]

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[13] Trane Air Conditioning Manual (The Trane Company: LaCrosse, Wisconsin, 1955), p. 343.

[14] Frederick T. Morse, Power Plant Engineering (D. Van Nostrand Company, Inc,: Princeton, 1953), p. 677.

[15] University of New Mexico, Financial Report, 1960.

Cost per year = 300 tons x 10.14 million BTU x [illegible]
ton [illegible] BTU

[illegible]

= $1419.30 per year.

In contrast to this, if individual reciprocating compressors were used with electric motors, the cost would be considerably greater. The efficiency of a reciprocating compressor is 80 percent.[13] The efficiency of a large electric motor is 90 percent.[14] Therefore, the yearly operating cost of individual units would be:

Cost per year = 300 tons x 12,000 BTU/hr x [illegible]

[illegible]

= $22,390.20 per year.

In summary, then, there is an appreciable saving to the University through the heating plant operation. The services supplied by the heating plant would cost an extra $20,971 per year more if it were to use separate units in individual buildings on the campus.

Below are listed [illegible]

[illegible]

[13] [illegible] Conditioning Manual [illegible]

[14] [illegible]

[15] [illegible]

Insurance	$ 1,243.02	
Repairs and Maintenance	6,118.17	
Retirement	775.56	
Salaries	26,537.60	
Social Security Taxes	644.12	
Supplies	691.50	
Applied General Overhead	12,273.96	
		$48,283.93

The costs of utility services if the heating plant were eliminated are as follows:

Present fuel costs for boilers[16]

$F_B = \$77{,}412.60^{17} \times 0.95^{17} = \$73{,}541.97$

Cost of Fuel for individual units

$$F_I = \frac{0.43 \times \$73.542}{0.33} = \$95{,}900$$

Savings by using "dump rate" gas

$C_F = \$95{,}900.00 - \$73{,}542.00 = \$22{,}400$

Extra expense if small boilers were used

$$C_B = \frac{\$95{,}900 \times 0.91}{0.53} - \$95{,}900 = \$68{,}800$$

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[16]Note: Assume 95% of the natural gas bill. This was verified by checking meter readings on both the boiler and campus gas meters.

[17]University of New Mexico, Financial Report, 1960.

Additional Cost if water were purchased from city

$$C_W = \frac{353,410,000}{1,000} \times (\$0.17-0.08) = \$31,800$$

Additional cost resulting from the use of individual, motor-driven, refrigeration compressors

$$C_R = \$22,600 - \$1,435 = \$21,165$$

Total additional costs of utility services if the University heating plant were not utilized

$$C_T = C_F + C_B + C_W + C_R$$

$$= \$22,400 + \$68,800 + \$31,800 + \$21,165$$

$$C_T = \$144,165$$

Yearly savings to the University through utilization of the heating plant

$$S = C_T - C_{H.\ P.}$$

$$= \$144,165 - \$48,284$$

$$S = \$95,881$$

SHORT FORM — A.S.M.E. TEST REPORT — DATA AND RESULTS OF BOILER TEST (1953) Page A

TEST NO. 1 BOILER NO. 1 DATE 7 JAN '58

OWNER OF PLANT UNIVERSITY OF NEW MEXICO LOCATION ALBUQUERQUE, NEW MEXICO

TEST CONDUCTED BY SENIOR ME CLASS OBJECTIVE OF TEST PERFORMANCE CHECK DURATION 9.5 HRS.

BOILER-MAKE & TYPE COMBUSTION ENGINEERING - PACKAGE RATED CAPACITY 45,000 # STEAM / HR

HEATING SURFACE, sq ft BOILER 6,255 WATER WALLS 535 ECONOMIZER —

" " " " SUPERHEATER AIR HEATER FUR. VOLUME, cu ft

STOKER, TYPE & SIZE GRATE AREA, sq ft

PULVERIZER, TYPE & SIZE BURNER, TYPE & SIZE

FUEL USED NATURAL GAS MINE COUNTY STATE SIZE AS FIRED

	PRESSURES & TEMPERATURES		
1	STEAM PRESSURE IN BOILER DRUM	psia	
2	STEAM PRESSURE AT S.H. OUTLET 207.3 PSIG + [illegible]	psia	219.61
3	STEAM TEMPERATURE AT	F	508.3
4	WATER TEMP. ENTERING (ECON.) (BOILER)	F	202.3
5	STEAM QUALITY % MOISTURE OR P.P.M.		
6	AIR TEMP. AROUND BOILER (AMBIENT)	F	77.7
7	TEMP. AIR FOR COMBUSTION (COMBUSTION AIR INTAKE)	F	77.7
8	TEMPERATURE OF FUEL	F	57.6
9	GAS TEMP. LEAVING (BOILER) (ECON.) (AIR HTR.)	F	435
10	AIR TEMP. LEAVING AIR HEATER	F	
11	DRAFT IN FURNACE	in. water	
12	DRAFT AT OUTLET (BOILER) (ECON.) (AIR HTR.)	in. water	
	UNIT QUANTITIES		
13	ENTHALPY OF SAT. LIQUID (TOTAL HEAT)	Btu/lb	363.84
14	" " " (SATURATED) (SUPERHEATED) STM	Btu/lb	1271.1
15	" " " FEED TO (BOILER) (ECON.)	Btu/lb	170.23
16	HEAT ABS. PER LB. OF STEAM (Item 14 − Item 15)	Btu/lb	1100.87
17	DRY REFUSE (ASH PIT + FLY ASH) PER LB AS FIRED FUEL	lb/lb	—
18	Btu per lb IN REFUSE (WEIGHTED AVERAGE)	Btu/lb	—
	HOURLY QUANTITIES		
19	*ACTUAL WATER EVAPORATED TOTAL 246,403 #	lb/hr	25,950
20	*RATE OF FUEL FIRING (AS FIRED wt) CORRECTED C.F. = 0.91	ft³/hr	37,100
21	TOTAL HEAT INPUT (Item 20 × Item 32) / 1000	kB/hr	31,535
22	" " OUTPUT (Item 19 × Item 16) / 1000 + Item 64	kB/hr	28,568
	FLUE GAS ANAL. (BOILER) (ECON) (AIR HTR) OUTLET		
23	CO_2	% VOL	8.026
24	O_2	% VOL	6.27
25	CO	% VOL	0
26	N_2 (BY DIFFERENCE)	% VOL	85.704
27	EXCESS AIR (Item 24 − Item 25) / Item 26 × 100	%	

*SEE NOTE PAGE B

	FUEL DATA — COAL AS FIRED PROX. ANALYSIS	% wt		OIL	
28	MOISTURE		42	FLASH POINT F	
29	VOL. MATTER		43	SP. GRAVITY deg A.P.I.	
30	FIXED CARBON		44	VISCOSITY AT BURNER SSU / SSF	
31	ASH		35	TOTAL HYDROGEN % wt	
	TOTAL		32	Btu per lb	
32	Btu per lb AS FIRED				
33	ASH SOFT TEMP. A.S.T.M. METHOD			**GAS**	**% VOL**
	COAL OR OIL AS FIRED ULTIMATE ANALYSIS		45	CO	—
34	CARBON	76	46	CH_4 METHANE	90
35	HYDROGEN	24	47	C_2H_2 ACETYLENE	—
36	OXYGEN	—	48	C_2H_4 ETHYLENE	—
37	NITROGEN	—	49	C_2H_6 ETHANE	10
38	SULPHUR	—	50	H_2S	—
31	ASH	—	51	CO_2	—
28	MOISTURE	—	52	H_2 HYDROGEN	—
	TOTAL	100		TOTAL	100
	COAL PULVERIZATION		35	TOTAL HYDROGEN % wt	
39	GRINDABILITY INDEX		53	DENSITY 60 F ATM. PRESS.	
40	FINENESS % THRU 50 M		54	Btu per cu ft	850
41	" % THRU 200 M		32	Btu per lb	

55	EFFICIENCY OF UNIT % (Item 22 × 100) / Item 21	28,568 / 31,535	91%

	HEAT BALANCE	Btu/lb A.F. FUEL	% of A.F. FUEL Btu
56	HEAT ABS. BY UNIT (Item 55 / 100) × Item 32		Item 55 728
57	HEAT LOSS DUE TO DRY GAS	2000	9.64
58	HEAT LOSS DUE TO MOISTURE IN FUEL	—	
59	HEAT LOSS DUE TO H_2O FROM COMB. OF H_2	2620	12.63
60	HEAT LOSS DUE TO CARBON MONOXIDE		
61	HEAT LOSS DUE TO COMBUSTIBLE IN REFUSE		
62	HEAT LOSS DUE TO RADIATION		
63	UNACCOUNTED FOR (BY DIFFERENCE)		
	TOTAL	Item 32 4620	100% 100.07

Set of 100 each Forms Nos. 2-2.1 and 2-2.2 obtainable from the A.S.M.E. Publication-Sales Department 29 West 39th Street, New York 18, N.Y.
Price, $3.00

SHORT FORM — A.S.M.E. TEST REPORT — CALCULATION SHEET (1953) Page 0

OWNER OF PLANT	TEST NO.	BOILER NO.	DATE

64 HEAT OUTPUT IN BOILER BLOW-DOWN WATER (TO BE ADDED TO ITEM 22) = LB OF WATER BLOW-DOWN PER HR × $\left[\dfrac{\text{Item} - \text{Item}}{1000}\right]$ = kB/hr

17 — If impractical to weigh refuse, this item can be estimated as follows
DRY REFUSE PER LB OF AS FIRED FUEL = $\dfrac{\text{\% ASH IN AS FIRED COAL}}{100 - \text{\% COMB. IN REFUSE SAMPLE}}$

65 CARBON BURNED PER LB AS FIRED FUEL = $\dfrac{76}{100} - \left[\dfrac{0 \times 0}{14{,}600}\right] = 0.76$

NOTE: IF FLUE DUST & ASH PIT REFUSE DIFFER MATERIALLY IN COMBUSTIBLE CONTENT, THEY SHOULD BE ESTIMATED SEPARATELY. SEE PARS. 129 & 156 ASME POWER TEST CODE FOR STATIONARY STEAM-GENERATING UNITS

66 DRY GAS PER LB AS FIRED FUEL BURNED = $\dfrac{11CO_2 + 8O_2 + 7(N_2 + CO)}{3(CO_2 + CO)} \times \left(\text{LB CARBON BURNED PER LB AS FIRED FUEL} + \tfrac{3}{8}S\right) + \tfrac{3}{8}S$

$$= \frac{11 \times 8.096 + 8 \times 6.67 + 7\,(85.74 + 0)}{3\,(8.096 + 0)} \times \left[0.76 + \frac{}{267}\right] + \frac{0}{160} = 23.3$$

67 THEO AIR PER LB AS FIRED FUEL BURNED = $11.53 \times 0.76 + 34.36\left(\dfrac{2.4}{100} - \dfrac{-}{800}\right) + 4.32 \times \dfrac{-}{100} = 17.01$

68 DRY AIR PER LB AS FIRED FUEL BURNED = $23.3 - 8\left(\dfrac{2.4}{100} - \dfrac{-}{800}\right) - 0.76 - \dfrac{-}{100} - \dfrac{-}{100} = 24.46$

HEAT BALANCE

Item		Btu/lb as fired fuel	%
56	* HEAT ABSORBED BY UNIT = $\dfrac{77.8}{100} \times 4620 = 3595$		Item ----
57	HEAT LOSS DUE TO DRY GAS = LB DRY GAS PER LB AS FIRED FUEL × Cp × ($t_{lvg.\ unit} - t_{air}$) = $23.3 \times 0.24 \times (435 - 77.8) = 2000$	2000	
58	HEAT LOSS DUE TO MOISTURE IN FUEL = LB H_2O PER LB AS FIRED FUEL ($1089 - t_{fuel} + Cp \times t_{lvg\ unit}$) When Item 9 < 575 F. Item 58 = $\dfrac{\text{-----}}{100}$ (1089 - ---- +0.46 -----) = When Item 9 > 575 F. Item 58 = $\dfrac{\text{-----}}{100}$ (1066 - ----- +0.5 -----) =	—	
59	HEAT LOSS DUE H_2O FROM COMB. OF H_2 = $9H_2$ ($1089 - t_{air} + Cp \times t_{lvg.\ unit}$) When Item 9 < 575 F. Item 59 = $9 \times \dfrac{2.4}{100}$ (1089 - 77.7 + 0.46 × 435) = 2620 When Item 9 > 575 F. Item 59 = $9 \times \dfrac{\text{-----}}{100}$ (1066 - ----- +0.5 -----) =	2617	
60	HEAT LOSS DUE TO CARBON MONOXIDE = $\dfrac{CO}{CO_2 + CO}$ × 10160 × CARBON BURNED PER LB AS FIRED FUEL = $\dfrac{\text{----}}{\text{Item} + \text{Item}}$ × 10160 × ----- =	—	
61	HEAT LOSS DUE TO COMBUSTIBLE IN REFUSE = ----- × ----- =	—	
62	HEAT LOSS DUE TO RADIATION = $\dfrac{\text{TOTAL BTU RADIATION LOSS PER HR}}{\text{LB AS FIRED FUEL}}$ OR ABMA RADIATION LOSS CHART PLATE 3 ASME POWER TEST CODE FOR STATIONARY STEAM GENERATING UNITS	415	2
63	UNACCOUNTED FOR (BY DIFFERENCE) $\dfrac{5072}{29750} = 24.3$		
	Eff. = 77.8 TOTAL	Item 30	100%

* WHEN DIRECT MEASUREMENT OF HEAT INPUT OR OUTPUT CANNOT BE MADE (ITEMS 19 or 20 UNAVAILABLE) THE EFFICIENCY CAN BE DETERMINED BY CALCULATING THE LOSSES AND SUBTRACTING FROM 100; MINOR LOSSES SUCH AS SENSIBLE HEAT IN REFUSE, LOSS DUE TO MOISTURE IN AIR, AND LOSS DUE TO UNBURNED HYDRO-CARBONS, NOT TABULATED ABOVE, CAN BE CALCULATED AS PER ASME POWER TEST CODE OR A NOMINAL, MUTUALLY AGREED UPON "UNACCOUNTED FOR" ITEM 63 ASSIGNED TO COVER THESE LOSSES.

Set of 100 each Forms Nos. 2-2.1 and 2-2.2 obtainable from the A.S.M.E. Publication-Sales Department 29 West 39th Street, New York 18, N.Y. Price, $3.00.

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