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Maintenance Budgeting.

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Three methods for the preparation of maintenance budgets are discussed--(1) a traditional method, inconclusive and obsolete, based on gross square footage, (2) the formula approach method based on building classification (wood-frame, masonry-wood, masonry-concrete) with maintenance cost factors for each type plus custodial service rates by type of area services (square footage serviced, salary, materials), and (3) the system of standards for work loading method based on minimum, median, and ideal standards for each custodial job. Exhibits in the article give applications of workload standards in housekeeping and a statistical analysis of the physical plant shop's maintenance budgets. (HH)

MAINTENANCE BUDGETING

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Business officers, more particularly those minions of the Business Office assigned the responsibility for analyzing and preparing total budgets for the University, have a nasty practice of asking disconcerting questions like, "Why do you need more money to hire more plumbers or more air conditioning mechanics?" or, "How do you know how many men you need?" These kinds of questions are calculated to cause physical plant administrators to lose sleep, grow ulcers or convert hair. There are ways to answer these questions with confidence and in a manner that establishes the physical plant man as an unquestioned authority so that forevermore the business officer dares not question the compelling need for any request received from Physical Plant. I say that there are ways that this can be done. Someday soon I hope I can find how to do this.

For purpose of discussion, three methods for preparation of maintenance budgets are offered for your consideration:

First, there is the simplest method -- an old standby which bases the maintenance budget upon the gross square footage of all buildings coupled with an experience factor and some guessing as to the percentage increase to apply on each anniversary of budget preparation. This method is for the most part inconclusive and obsolete. Let me illustrate this -- When completed in 1952, the North Carolina State Biological Sciences Building had a faculty-staff population of 80 people occupying 102,000 square feet. In the intervening time, seminar rooms and classrooms were subdivided into office and research laboratory cubicles. In 1966 (still only 102,000 square feet) there is a population in excess of 500. Application of a square footage formula would not allow for an increase of custodial personnel required or the supplies and utilities required for the operation of the building. Further evidence of the fallacy of this method is in its inconsistency; e.g., the North Carolina State gym has five men assigned 39,500 square feet per man; Civil Engineering building, three men, 26,000 square feet per man; and the General Laboratory building, 4.5 men, 14,500 square feet per man.

Second, there is a method called "Formula Approach" to financing physical plant operation. Howard Badget, Director of Physical Plant at Texas A & M University, presented a paper on this subject at the 51st Annual Meeting of the National Association of Physical Plant Administrators of Colleges and Universities, Trinity University, San Antonio, Texas, in April of 1964.

Mr. Badgett told us that ". . . .There are seventeen elements of institutional cost considered in the preparation of these budgets. Five of these elements (including two physical plant activities), representing approximately 72 per cent of the total institutional cost, are now being determined on a formula basis. . . ."

The two physical plant elements determined on a formula basis are Building Maintenance and Building Operations or Custodial Services.

For the first, Building Maintenance, the formula is built around the classifications of building construction --

(1) Wood-frame construction
(2) Masonry-wood (wood floors and wood-frame partitions)
(3) Masonry-concrete or masonry-steel frame, fireproofed and with concrete floors.

"The amount to be allocated for building maintenance for any group of structures may be determined by applying a maintenance cost factor to the total replacement cost for each construction classification. This maintenance cost factor is a percentage of the replacement cost and will vary for the three building classifications. . . ."

"To assist in applying this formula. . . .an appraisal chart prepared and published by the Markel Appraisal Chart Company of Cincinnati is used. This chart is revised semi-annually in January and July and is utilized by appraisal agencies, insurance firms, and loan organizations to determine building reproduction costs, the insurable value, or the loan or sales value of buildings. The current reproduction cost of a building is obtained simply by multiplying the original building cost by the factor given in the table for the type of construction and year built."

The maintenance cost factors determined by the Texas group are:

"Construction Classification	Maintenance Cost Factor
Wood Frame Construction	1.75%
Masonry-wood Construction	1.30%
Masonry-concrete or masonry-steel and concrete floors	1.10%

'That cost factors be increased by 0.15 per cent for air conditioned buildings.

'That the Markel Appraisal Chart be utilized to determine current replacement costs of buildings.

'That these cost factors need not be adjusted to cover increased age of buildings, or increased cost of labor and materials, because this is automatically provided in determining the current replacement cost of the building. Supervisory costs, other than work foremen, are not

covered by this formula but should be provided separately. Maintenance requirements computed by this formula method provide only for current normal maintenance based upon the assumption that buildings are in good repair with no backlog of deferred maintenance. Deferred maintenance and major rehabilitation must be provided separately and beyond the funds estimated under this formula and must be justified individually by the institution concerned."

Second, Building Operations or Custodial Services -- this formula is built on three variables:

"(1) The number of square feet to be serviced by a full-time employee.
(2) The average salary paid employees.
(3) The quantity of materials, supplies, and equipment required to perform those services."

The Texas formula considered the following factors in arriving at a cost formula for custodial services at the 18 Texas institutions:

"(1) An average of 14,000 square feet of gross floor space assigned per full-time custodian; (2) $205 per month, or $2,460 per year, average salary base per full-time custodian for a 40-hour week; (3) an allowance of $246 per year (ten per cent of average salary base) for materials, supplies, repairs, replacements, and purchase of new equipment necessary for providing custodial services per full-time custodian.

'These factors resulted in a rounded figure of 19 cents per square foot of gross area per year for custodial services." The variables would have to be re-assessed for each budget anniversary .

The third method of maintenance budgeting is best described as a system of standards for workloading. This method is being employed by North Carolina State University at the present time. The idea and some of the techniques were borrowed from the University of Minnesota.

Here's how it works for housekeeping --

Workloading is determined by the man's capability for performing his daily task of housekeeping individual areas; such as office, classroom, laboratory, bathroom, etc. Time studies for the routines have been observed for twelve months. Time standards have been established for typical rooms in the same or similar categories.

1. MINIMUM STANDARD (Does not include window washing, floor maintenance or evening school work)

Offices, lounges, libraries, conference rooms, classrooms and laboratories

Daily - Unlock door and turn on lights
Dust room
Clean out ash trays on desks, tables, etc.
Empty trash cans
Sweep room floor
Turn out lights -- lock door
In addition to above -- clean chalkboards, chalk trays and erasers, where present

Weekly - Vacuum rugs once a week

Bathrooms ---

Daily - Clean and disinfect all urinals, commodes and lavatories
Wet mop floor
Clean and wash all mirrors.

Weekly - Thoroughly clean bathroom (includes scrubbing all tile)

Halls and Stairways ---

Daily - Sweep and dust

Weekly - Damp mop at least once per week

2. MEDIAN STANDARD (With window washing and floor maintenance included)

To Minimum Standard, add the following:

Daily - Buffing of floors
Spot Cleaning walls
Vacuuming of rugs

Weekly - Dusting of venetian blinds and special furniture

Semi-Annually - Washing of windows

Floor Maintenance - Special crew on scheduled cycle for stripping, waxing, and refinishing floors

3. IDEAL STANDARD

To Median Standard, add the following:

Daily - Brass polishing

Twice Daily - Cleaning of heavily loaded classrooms, blackboards, and erasers

Weekly - Cleaning of light fixtures

Washing of venetian blinds annually
Shampooing of rugs annually.

Special services that include moving of furniture and equipment within a building, and more frequent dusting of high areas.

Evening school service.

Each janitor works seven hours each day Monday through Friday and five hours on Saturday. The time standards established by room are in minutes:

	Ideal	Median	Minimum
2-Station Office	12	10	8
30-Station Classroom	25	20	15
20-Station Laboratory	30	25	20
15-Station Conference Room	20	15	10
10-Station Lounge	17	15	10
Small Library	21	15	10
6-Fixture Bathroom	23	20	20
Stockroom (150 sq. ft.)	7	5	3
2-Man Bedroom	12	12	10

The workload standards established on an average one area foreman for each ten workmen and one janitor foreman for each three area assignments.

Workload Procedure:

1. Catalog building as follows: Office, classroom, laboratory, etc.

2. Study times of several different janitors performing duties at a normal rate, observing different methods employed by each janitor.

3. Average all times in like areas. This establishes a basis for your total work force in calculations of future workloads in new buildings or additions to existing buildings.

4. Divide building into floors. Calculate each floor workload by multiplying number of areas by their respective average times for cleaning. For instance; 6 offices at 10 minutes per office is 60 minutes of time required.

5. Add all times together. Divide by 420, 480 or the number of minutes janitors work each day. The result is the number of men required to perform the duties at the level of housekeeping desired.

6. Classify the positions. Multiply the number of positions by the wage proposed, and the budget request is established.

For example of application of workload standards in housekeeping, see Exhibit "A".

Workloading for maintenance of buildings by the trades shops is developed in much the same way that workloading for housekeeping is developed. Here, however, the workload standards vary from shop to shop, depending upon the unit of work for the respective trades and the capability of one workman for an annual production in his particular specialty.

Exhibit "B" is a statistical analysis of the physical plant shop's maintenance budgets, defining the responsibility of each shop by showing unit workloads with the annual output possible for one workman. This is based upon an 1800-hour productive year. Physical Plant is scheduled for 40 hours a week or 2,080 hours a year; however, three weeks of vacation, two weeks of holidays, and two weeks of sick leave reduce the 52 weeks to 45 weeks at 40 hours, or 1800 hours per year.

By taking the unit workload and dividing it into the workload which is the responsibility of that shop, the workmen required becomes a simple answer. For example, in the Auto Shop, the workmen required becomes a simple answer. For example, in the Auto Shop where currently there are 20 pieces of heavy equipment (18 pieces of heavy equipment is all that one workman can take care of in a year's time), it is determined that 1.11 workmen will be required for this increment of the load. Accordingly, 338 autos and trucks require 5.63 workmen; 100 pieces of light equipment require 1.11 workmen -- for a total of 7.85 workmen in the Auto Shop. The budget currently provides six workmen. This is two workmen short, and what this means is that the current operation of the Auto Shop is not getting the job done that should be done. There are always pieces of equipment broken down, needing servicing or repair, that are not getting the service. This means that the other work programs of the University are inconvenienced by the inability of this shop to keep up with its work. The two additional workman needed are projected as a mechanic and a helper. Pay grades are shown; starting salaries are shown; budget increases are shown. The same routine applies to the projected needs for the fiscal year 1967 through 1969.

Of interest to those planning maintenance budgets are the units of work that we have determined as the capacity of one workman for one year's work. For example, in the area of hardware it has been determined that 4,000 doors can be maintained on schedule by one workman. The number of doors on the North Carolina State campus are shown. Also shown are the number of windows. The window repairs, on a limited basis, involve the hardware mechanic. Primarily, the maintenance of windows will be the function of the glazier in the Paint Shop or the welder in the Pipe and Metal Shop.

In the Paint Shop the term, "paintable surface", refers to walls, ceilings, and trim (both interior and exterior). Here the annual output for one workman is pegged at 90,000 square feet. This figures out in hours as 50 square feet per hour, which seems a low figure until you consider the time spent in preparation and the time required for trim painting.

In the Pipe Shop the unit workloads have been related to the number of plumbing fixtures on campus. It was determined that an annual unit workload for a plumber was in the number of fixtures that a plumber could service on a scheduled maintenance basis. Because of the way the North Carolina State Pipe Shop is organized, the workmen in this shop do plumbing, steam fitting, welding, and other miscellaneous repair work. It was determined statistically from our cost distribution records that 58% of the effort of this shop was in the area of plumbing; 42% for steam fitting, welding, and other items. Therefore, a "plumber" working 53% of the time can take care of 348 lavatories, urinals or sinks; or a combination of the three. Or, he could service 262 commodes or showers; or a combination of the two. If he were to work 100% of the time as a "plumber" his unit workload would be 600 lavatories, urinals or sinks; or 450 commodes or showers.

In areas of maintenance relating to plastering, sheet metal, brick masonry, roofing, carpentry work or general electrical maintenance, unit workloads have not been related to specific functions of work. Here the unit of work is identified with gross square footage. As this system is refined and as it becomes more sophisticated, it is anticipated that unit workloads relating to specific functions will be set up for these areas.

Under the Shop column, in addition to the name of the shop, are shown values for: "A" - Appropriation; "S" - Self support; and "D" - Departmental Services. These values are in terms of percentage of labor dedicated to the particular category. This information is necessary in budget planning since increasingly it becomes necessary to derive funds from more than one source. The percentage value shown for each shop at North Carolina State will not necessarily apply to the shops at other institutions since the work of each shop is dependent on the responsibility assigned that shop and the scope of work covered by each shop.

For North Carolina State the values for budgeting the total operation are:

Appropriation	-	62%
Self-Support	-	16%
Departmental Services	-	22%

This is based upon cost accounting distribution for the fiscal year of 1964-65.

EXHIBIT "A" April 4, 1966

North Carolina State UNIVERSITY

JANITOR MANPOWER WORKLOADS

Appropriation Support

Floor maintenance and window washing is not provided in the minimum standard of workloading; however, these men are assigned and are performing. They are shown added (*) to the janitors now employed and to the minimum workload requirement.

Academic Buildings	Ideal	Median	Minimum	Now Employed
Ag. Engineering	3.10	2.60	2.10	2.20
Animal Disease	1.19	.62	.50	.80
Brooks	3.50	3.05	2.50	3.00
Broughton	4.80	4.00	3.20	2.75
Burlington	.40	.40	.37	.55
Carmichael	6.20	5.90	5.18	5.00
Clark Laboratories	3.00	2.60	2.10	2.00
Daniels	7.42	7.10	5.70	3.00
Field House	.60	.50	.40	.50
Gardner	8.60	8.02	6.48	5.00
General Lab	6.50	5.83	4.73	4.75
Harrelson	8.30	8.00	7.00	6.00
D. H. Hill	3.76	3.50	2.84	3.00
Hodges	.40	.37	.30	.25
Holladay	3.35	3.10	1.56	2.00
I.E.S.	.57	.50	.40	.40
Kilgore	4.23	3.81	3.37	2.00
King	1.62	1.51	1.23	1.00
Leazar	1.00	.89	.74	.30
Mann	4.20	3.50	2.82	3.00
Morris	1.60	1.09	.91	.50
Nelson	6.23	5.00	4.12	4.00
1911	3.90	3.50	3.00	3.00
Nuclear Science	.80	.75	.60	.25
Page	1.86	1.60	1.30	1.00
Park Shop	1.06	.71	.56	.85
Patterson	3.65	3.22	2.61	2.00
Peele	1.75	1.61	1.28	1.50
Polk	7.00	6.04	4.95	4.00
Primrose	.39	.34	.28	.20
Reynolds Coliseum	2.00	2.00	2.00	2.00
Ricks	3.00	2.50	2.00	2.00
Riddick	7.14	6.90	5.61	4.00
Robertson	1.50	1.42	1.00	.75
Scott	1.90	1.78	1.47	1.00
Frank Thompson	.46	.40	.35	.10
Tompkins	3.44	3.04	2.69	2.00
Watauga (Basement)	.35	.29.	.25	.10
West Stadium	.30	.20	.10	.25
Williams	8.50	7.13	5.16	4.00
Winston	3.00	2.10	1.62	2.00
Withers	4.50	4.07	3.25	3.00
Sub-total	137.07	121.49	97.63	86.00
*Floor & Window Crews			16.00	16.00
TOTAL	137.07	121.49	113.63	102.00
Less Now Employed	102.00	102.00	102.00	
Required Additions	35.00	19.00	12.00	

EXHIBIT "A" - CONTINUED

Supervisors required to direct workmen:

	Now Employed	For Median Level
Floor Crew Foreman	1	1
Janitor Foremen	2	4
Mail Foreman	1	1
Area Foremen	8	12
TOTAL	12	18

EXHIBIT "B" — TRADES MAINTENANCE WORKLOADS — April 4, 1966

North Carolina State University - Physical Plant Division

Shop	Area of Responsibility Definition of Workload		Unit Workloads - Annual Output One Workman	Workmen Now Provided	Workmen Required 65-67	Workmen Required 67-69	Additional Workmen Needed: Classification	Pay Grade	Minimum Salary	Budget Increase 65-67	Budget Increase 67-69
Auto	Campus automotive equipment										
*A-72%		65-67 / 67-69									
S-	Heavy equipment	20 / 27	18 pcs.hvy.equip.	6	1.11		1 Mech.	58	$4,752	$4,752	
D-28%	Autos & trucks	338 / 450	60 autos		5.63		1 Helper	49	3,120	3,120	
	Light equip.,lawnmowers,pumps,etc.	100 / 135	90 pcs.light equip		1.11						
					7.85						
						1.50	1 Mech.	58	4,752		$4,752
						7.50	1 Helper	49	3,120		3,120
						1.50					
						10.50					
Carpenter	3,710,000 sq.ft. -- 65-67						July '66				
A-37%	4,990,000 sq.ft. -- 67-69		200,000 sq.ft.	15	18		2 Mech.	56	4,320	$8,640	
S-25%	Buildings,fixtures &						1 Helper	49	3,120	3,120	
D-38%	furnishings										
						25	4 Mech.	56	4,320		$17,280
							3 Helpers	49	3,120		9,360
Elect.		65-67 / 67-69									
Primary	Circuits in lin.ft.	62,000 / 103,000	30,000 l.f. circuit	3	2.06		1 Mech	61	5,484	5,484	
	Transformer stations	71 / 84	60 Trans.stations		1.18		1 Helper	54	3,936	3,936	
	Main Switches	308 / 328	225 Switches		1.37						
					4.61						
						3.43	1 Mech.	61	5,484		5,484
						1.40					
						1.45					
						6.28					

*Percentage of Budget - Labor only
A - Appropriated Support
S - Self Support
D - Departmental Services

EXHIBIT "B" Continued

Shop	Area of Responsibility Definition of Workload	Unit Workloads - Annual Output One Workman	Workmen Now Provided	Workmen Required 65-67	Workmen Required 67-69	Additional Workmen Needed: Classification	Pay Grade	Minimum Salary	Budget Increase 65-67	Budget Increase 67-69
Elect.	Panels, lighting									
Second	3,710,000 sq.ft. -- 65-67									
A-67%	4,990,000 sq.ft. -- 67-69	250,000 sq. ft.	14	15		1 Mech.	59	$ 4,980	$ 4,980	
S-13%	Power & convenience outlets									
D-20%	Building equipment				20	2 Mech.	59	4,980		$ 9,960
						3 Helpers	49	3,120		9,360
General	Plastering, sheet metal, brick	200,000 sq. ft.	12	18		3 Mech.	59	4,980	14,940	
A-63%	masonry, concrete & roofing					3 Helpers	49	3,120	9,360	
S-21%	3,710,000 sq. ft. -- 65-67									
D-16%	4,990,000 sq. ft. -- 67-69				25	4 Mech.	59	4,980		19,920
						3 Helpers	49	3,120		9,360
Lock	Hardware-Locks, door closers,									
A-58%	hinges, window latches, etc.	4,000 doors	3	5		1 Mech.	57	4,536	4,536	
S-36%	65-67 67-69					1 Helper	54	3,936	3,936	
D- 6%	Doors 19,400 26,000									
	Windows 15,100 20,000				6	1 Mech.	57	4,536		4,536
Paint	Interior & Exterior Paintable									
A-66%	surface areas based on 7-yr	90,000 sq. ft				1 Asst.-				
S-14%	cycle	paintable surf				Fore.	59	4,980	4,980	
D-20%	2,120,000 sq.ft. -- 65-67		12	24		11 Mech.	56	4,320	47,520	
	2,851,000 sq.ft. -- 67-69				24					
Pipe	Plumbing - 58%									
A-59%	Steamfitting, etc. - 42%									
S-22%	65-67 67-69			11.3		2 Mech	59	4,980	9,960	
D-19%	Lav.,urinals,sinks 3933 5250	Lav., urinals,		7.6		2 Helpers	54	3,936	7,872	
		and sinks -348	15	18.9						
					15.1	3 Mech.	59	4,980		14,940
	Commodes & showers 1982 2670	Commodes &			10.3	3 Helpers	49	3,120		9,360
		showers - 262			25.4					