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Principles for guiding the administrative officer in charge of developing a service organization on a campus and a brief description of main components of plant planning are given. The rationale and implementation in areas of personnel, finance, and facilities are discussed and recommendations for maintaining a physical plant planning office are outlined. Particular stress is given to delineation of the respective areas of responsibility of institution administrators and physical plant administrators. (HH)

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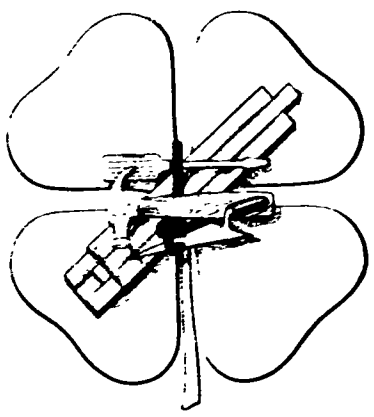
FUNDAMENTALS OF PHYSICAL PLANT MANAGEMENT, PLANNING AND CONSTRUCTION



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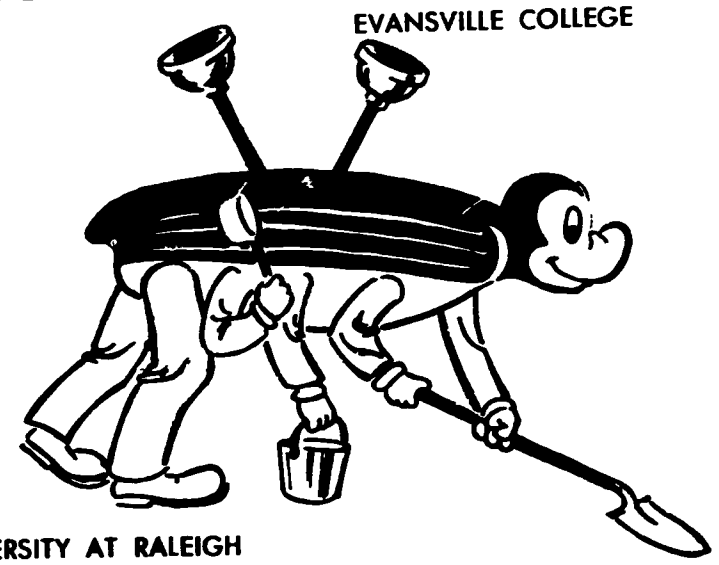

N. C. STATE UNIVERSITY AT RALEIGH

National Association of Physical Plant Administrators of Universities and Colleges

FUNDAMENTALS OF PHYSICAL PLANT MANAGEMENT, PLANNING, AND CONSTRUCTION

National Association of Physical Plant Administrators
of Universities and Colleges
$1.00

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A large part of Part 2, "Programming, Planning, and Construction of College and University Buildings" was prepared by Sam F. Brewster and presented at the Annual Meeting of the National Association of Physical Plant Administrators in 1963.

May 1, 1966

CONTENTS

INTRODUCTION

Here is a compendium of principles to provide a guide for the administrative officer whose responsibility it is to develop a working service organization on his campus. He may, regardless of the size or character of his college or university—whether private or public, urban or rural, find definitions, philosophy, or criteria that will assist him in focusing on his particular situation.

Effort has been made to include all facets possible or probable. (This is not a promise of infallibility.) For the small in size this will mean a selective combining to develop the organizational "structure" in proper scale. For the large in size a judicious arrangement for specific application should serve the purpose.

- The newly formed college or university will find here a foundation for the establishment of sound practices.

- The older institutions with growth and expansion problems and an archaic or non-existent physical plant organization may chart a pattern for progressive accomplishment and dynamic organization.

- Those established colleges and universities with modern and aggressive concepts of physical plant management may choose to contribute further enlightenment to the subject or to reorganize areas of responsibility to conform with the principles set forth here.

Consultation is available from such organizations as the National Association of Physical Plant Administrators of Universities and Colleges, regional associations of Physical Plant Administrators, and College and University Business Officers' regional associations.

PART I

FUNDAMENTALS OF COLLEGE AND UNIVERSITY PHYSICAL PLANT MANAGEMENT

Chapter I

MISSION

The mission of the Physical Plant organization is to provide the services required to operate, maintain, expand, plan and construct the physical facilities of the college or university.

An order of importance of functions might be:

First, *service* responsibility—A commitment of personnel to handle assignments of service to the university in an efficient, courteous, prompt, dedicated, professional, and technically correct manner.

Second, *operation* is a primary responsibility—in areas where budgets are specifically provided for the service in areas where other departments or auxiliary enterprises pay for the service.

Third, *maintenance* is a most important responsibility—to create a physical plant environment that is as nearly trouble free, safe, and competent as possible.

Fourth, *alterations, modifications, and minor new construction* should be executed by Physical Plant forces or a contractor under Physical Plant direction. In no case should construction, alteration, or repairs be performed by academic departmental staff or students. Experience has proven that alterations, construction, or repairs when performed by non-professionals result in an incompetent, unsightly, and unsafe product often in violation of building codes.

Fifth, *new construction*—Physical Plant has a responsibility to insure the best and most serviceable features in new construction and major remodeling to obtain the lowest maintenance and operation costs for the life of the structure.

FUNCTIONS TO CARRY OUT MISSION

- *Operation of systems*—heating, cooling, power, ventilation, water supply, refuse disposal, sewage disposal, traffic control, safety, and security.
- *Services support*—graduation, registration, special program setups, anniversaries, homecomings, athletic contests, and other similar special occasions.
- *Maintain* buildings, streets, utilities systems, grounds equipment (including auto and mechanical), and furnishings.
- *Planning* (when assigned) to phase into being the growth objective of the university—
  By interpretation of needs into space relationships
  Programming of building projects
  Utilities to adequately serve requirements

Traffic, people, cars, bicycles, horses, etc.
Space modifications and alterations
Planning will distinguish itself into two major categories—long-range and the day-to-day campus operational planning requirements.

- *Construction*—
  Major capital improvements—new or total rehabilitation (contract).
  Minor new construction, major repair (University forces or contract).
  Alterations, modifications, partial rehabilitation, minor repairs (University forces).

Chapter II

FISCAL RESPONSIBILITIES

It is the obligation and duty of the Physical Plant Division to properly estimate and project future costs of operating and maintaining the physical plant. These estimates should be based upon the latest figures of the university's projected enrollment and academic program which the university administrative and planning groups have developed.

It is equally the obligation and duty of the Physical Plant Division to set up and provide efficient, accurate accounting procedures so that all funds assigned are properly accounted for, and so that the budget standing in each major account of the division is reviewed not less than once each month.

The request for funds for maintenance and operation of the physical plant might appear to be in direct competition with the requests for teaching, research, and capital outlay for plant expansion. We have to have all of these. The maintenance and operation budget requests must be based upon facts and statistics. Clearly defined policies must be established as to what portion of an expense is to be borne by the Physical Plant Division. Chief administrators are interested in costs and cost distribution. It is important that costs be correctly identified and posted.

Physical Plant divisions have the responsibility for preparing detailed budgets for the administration and operation of all of their assigned functions. Such budgets should not only contain information on needs for teaching support (operational funds), but should also anticipate revenue to be derived from special projects, auxiliary services, departmental services, and other revenue producing sources. The budget breakdown would indicate amounts for salaries, supplies, equipment, utilities, travel, etc. The total of these items would constitute the asking budget of the Physical Plant Division.

In order to make an intelligent and reasonable budget, it is necessary to have adequate and reliable figures on past performances and costs. Such information is readily available if the Physical Plant Division is operating on a sound work or job order system. If there are no significant changes in the physical plant from one year to the next, budgets may be scaled upward or downward, depending on quality of service demanded or upon the extent of university funds available. As acreage and square footage are added, units of cost can be established based on previous experience, and logical increases may be requested and justified.

When the Division of Physical Plant receives its approved budget, and adjustments, if any, are made, it then becomes the responsibility of the administrator of Physical Plant to prepare or assist in preparing a working

budget. When this has been done the various units comprising the Division of Physical Plant should be given their budget.

It is desirable that Physical Plant have an accounting section even though the official school accounting is done elsewhere. It is felt that the details required in a successful plant operation would be a burden on central accounting and that such information, if available, would be too slow in reaching the administrator.

Controls should be set up in the Physical Plant accounting office to see that the division operates within its given and anticipated financial resources. A successful method is to break the budget down into monthly allotments. At the end of each month a comparison is made between budgeted amounts and actual expenditures and commitments. Overspending is thus quickly detected and brought into line before it is too late.

Chapter III

THE PEOPLE IT TAKES TO MAN THE PHYSICAL PLANT—PERSONNEL AND PERSONALITY

The following description of positions and the part they play is recommended as best practice for university and college physical plants, ranging from small to large, private to public, poor to rich.

THE DIVISION HEAD

Preferred title—Director of Physical Plant
Options—Director of Maintenance & Operations
Superintendent of Buildings & Grounds

Primary requisites—Leadership, philosophy of education process, professional training (including engineering, architecture, landscape architecture, and public administration), professional attitude, and maturity. Related experience is desirable. He usually reports to either the *President, Vice-President* of Business Affairs, or *Business Manager.*

Primary functions—Plans, organizes, supervises, and controls the services required for the expansion, development, maintenance, and operation of the physical facilities of the campus; interprets and applies the policies of the chief campus officer and the university; conducts all functions and responsibilities fully, effectively, economically, and harmoniously.

THE PRINCIPAL ASSISTANTS TO THE DIVISION HEAD

The primary requisites are leadership, professional training, and related experience. The primary functions are to develop and direct the procedures and programs for the incremental area of the Physical Plant complex specifically assigned to them. The following areas of responsibility are suggested as increments suitable for finite subdivisions in the Physical Plant organization. These units are not necessarily all-inclusive or exclusive. For large schools there may be a unit for each function named. For the small schools the functions named may be combined into any suitable combination for a single department.

Buildings
Grounds
Utilities
General Services
Shops
Transportation
Engineering
Architecture

Landscape Architecture
Planning
Contract Construction
Departmental Services
Security
Safety and Civil Defense
Medical
Research
Extension
Housing
Office Management
Procurement and Stores

Good management practices stipulate that the number of people reporting to one man should not exceed eight.

It is recognized that the academic departments on campus have many technical and professional talents within those departments. Their primary responsibilities are for teaching. They cannot be expected to accept responsibility for administrative assignments or for policy making for physical procedures. Physical Plant administrators are counseled to utilize these talents from the academic departments on a consultation basis for specific problems only.

PROFESSIONAL STAFF PERSONNEL

Individuals highly trained, highly skilled, highly intelligent, and usually work as individuals at a professional level. Examples are engineers, architects, landscape architects, etc.

ADMINISTRATIVE SUPPORT STAFF

Individuals trained, experienced, intelligent, and work as individuals or groups. Examples are secretaries, draftsmen, technicians, cost accountants, bookkeepers, store managers, etc.

CLERICAL

Intelligent, experienced, formal training. Examples are telephone receptionists, typists, file clerks, office machine operators, mail men, stock clerks, inventory clerks, property custodians, etc.

OTHER CATEGORIES OF SUPERVISION

Supervisor or *Foreman* (Responsible for all areas in a given classification)
Primary requisites—Leadership, experience, and at least high school training.

Primary functions—This man would directly coordinate the use of manpower and material to get the job done.

Foreman, Sub-Foreman, Area Foreman, or *Leadman*
Primary functions–Personal supervision of smallest elements of work crew. (Assign task to the lowest capable echelon.)

WORKMEN

Personnel necessary to operate machines or do manually executed tasks when given direction and supervision. (Designation of specific categories by individual colleges may be limitless. Category designations may be complex.) General designations are as follows:

- *Specialists, technicians, or artisans*–Individuals here are highly trained, highly skilled, and intelligent. May work in groups but generallv will work as individuals; for example, high voltage power linemen, electronics technicians, control system specialists, sign painters, cabinet makers, etc.

- *Skilled workmen, tradesmen, or mechanics*–Personnel in this category are skilled because of training or experience or both. They work as groups or as individuals, performing assigned tasks within the scope of their trades or skills; for example, auto mechanics, truck drivers, carpenters, painters, plumbers, electricians, brickmasons, refrigeration and air conditioning service mecahnics, etc.

- *Helpers, trades apprentices, or semi-skilled*–These individuals work closely with skilled workmen. They usually are young and inexperienced. They are intelligent and should have aptitudes for the skills to which they aspire. Examples here are carpenters' helpers, plumbers' helpers, electricians' helpers, engineering aids, etc.

- *Intermediately Skilled*–These individuals perform routine tasks as groups or as individuals, do not require extensive experience or training, should be intelligent and of a high order of integrity. Examples are messengers, delivery men, handymen, furniture movers, street cleaners, refuse collectors, grounds men, general utility men, janitors, custodial workers, and construction laborers.

- *Unskilled* workmen have not been given a category in these listings, because, while unskilled persons are employed, the Physical Plant organization properly managed and oriented places these individuals in positions where they become members of the team and are imbued with a career attitude and trained to do the tasks that will be assigend them in a professional workmanlike manner. The high standard of maintenance necessary at a university or college cannot afford the luxury of untutored, unskilled, insensitive individuals. The foundries and forges now seek high school graduates to pour hot metal into molds. Prospective employees for a physical plant division should be literate, intelligent, and responsible. This promotes efficient, effective utilization.

Chapter IV

RELATIONSHIP TO OTHER ADMINISTRATIVE OFFICES AND DEPARTMENTS

The inter-relationship between all groups should be harmonious and co-operative.

Physical Plant, in its relationship to the administrative functions under the Business Office, such as Purchasing, should have a position with a designated responsibility for procurement to work closely with the Purchasing Agent to obtain the needs for the physical plant. In the case of the smaller schools, it may be that this procurer for Physical Plant and the Purchasing Agent for the university would be one and the same man.

Where there is a university personnel program, Physical Plant, because of its nature and relatively high turnover of employees, would have to have a person with designated responsibilities relating to personnel. This person would work in close liaison with the central Personnel Department.

Chapter V

PHYSICAL PLANT COMPLEX

BUDGETS

Physical Plant budgets are a major portion of the total university expenditure and range from 10 to 20% in a majority of cases.

- The most recent trend in budgeting for physical plant has to do with formulas[1] which relate to the age and character of the building (current replacement) and are calculated to provide the necessary funds to properly and adequately take care of current maintenance as well as deferred maintenance.
- Another method of maintenance budgeting is based upon a rather sophisticated system of assigning maintenance function values to all classes of space, dependent on type of use.[2] This work load system is calculated to provide the necessary funds for a standard of maintenance satisfactory to the institution. Merit is in its adaptability to the constantly changing use of space on the campus.
- There is another system which is less satisfactory and less reliable in interpretation which provides for determining a maintenance budget based upon square footage of space. This system, older and now considered obsolete, was reasonably satisfactory in the days when educational process was largely reading, writing, and arithmetic confined to four walls and a roof.

One of the most difficult and time consuming duties of the Director of a Physical Plant is the preparation of appropriations requests for operations and maintenance funds. To submit accurate indication of the funds required for use in any budget year, the Director is called upon to use every possible unit of measurement at his command.

The request for an appropriation at the very least is an estimate based upon past experience, plus requirements for the unforeseen. That part of the estimate based upon past experience is only as good as the records that have been kept relating to the experience. Therefore, accurate, complete maintenance records serve as an invaluable aid in the compilation of the request for appropriations.

In order to control costs and to understand the purpose of a budget, there should be a series of budgets, grouped under a general heading of

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[1] "A Formula Approach to Financing Physical Plant Operations"—W. H. Badgett, Director of Physical Plants, Texas A & M—1964.

[2] North Carolina State University—Charles Braswell: University of Minnesota—Joe Leverone.

"Maintenance and Operation of the Physical Plant." Establishment of unit cost records and support data for requests are useful by-products.

ACCOUNTING, RECORD KEEPING, JOB ORDER SYSTEM, ETC.

The advent of automatic data processing is offering a whole new concept to physical plant accounting, record keeping, billing, and other business procedures. This treatise would not attempt to explore all the ramifications possible or probable.

Cost accounting distribution and work order systems are basic to Physical Plant management. The information to support these necessary activities or systems is generated at the various levels within the Physical Plant organization. In most cases it is thought advantageous for the keeping of records, compilation of results, and reporting on results as inherently a function for Physical Plant.

Cost distribution has been easily adapted to machine posting and simply posts charges for labor and materials to the various job order classifications. The determination and identification of the amount of the charge is made at the point of origin by the work crew or shop foreman who makes a daily report which is turned in to the cost accounting section. Also, from this information may be taken payroll information, personnel records information relating to leave, holidays, sick leave, etc. This avoids duplication and keeps accumulation of records in its simplest possible form.

The *job order system* has two classifications:

- First, the maintenance job orders, or orders, relating to maintenance of physical facilities. These job orders can be established as routine or standing identifications with a two-part number, the first part to indicate the function and the second part to indicate the location or application of the function.
- *Second,* job orders for departmental requests or services. Services rendered by Physical Plant will be billed to the requesting department. These work orders may be based upon properly approved requests from the department, which will pass through the hands of the department head, to the academic dean concerned, to the Busines Manager, who will in turn approve the source and amount of funds, and finally to Physical Plant where confirmation as to the scope and feasibility of the project will be approved before issuance of the job order.

SPACE UTILIZATION

Space utilization as a matter of policy or the nature of implementation of the program of space utilization is not properly a function of Physical Plant.

MAINTENANCE

The basic budget of the Physical Plant Division on a continuous basis

provides for the forces and materials needed to provide *the* satisfactory standard of maintenance.

The Physical Plant Division should be organized to do preventive or scheduled maintenance on a repetitive, never-ending program. Specialist crews of men are given schedules requiring periodic inspection, adjustment, and repair to classes of maintenance such as hardware, lighting fixtures, plumbing fixtures, heating equipment, floors, painting, carpentry, etc.

Items such as roof replacements (deferred maintenance) are accomplished by annual inspections for condition and staging replacements to phase the replacement before failure of the roof can significantly damage the building or its contents.

Another popular trend is to "Zone Maintenance": A crew of men are assigned to a particular area or space where they perform all functions required for that space. In addition to the above, the trades shops render the necessary services to combat breakdowns and answer demands on deferred maintenance to utilities systems, etc.

HOUSEKEEPING

Trends in housekeeping require establishment of work standards systems to assure a uniform quality throughout all areas on campus and to achieve maximum efficiency and utilization of manpower and material. There are specialist crews for washing windows, for cleaning bathrooms, cleaning blackboards, etc.

LABOR UNIONS

The Physical Plant Division should be constantly mindful and aware of the needs, desires, and motivations of each individual of its work force. The department should endeavor to pay all groups, both skilled and unskilled, as close to the local market for each group as the budget will permit. Also, all reasonable employee benefits—working schedules, showers, lockers, lunch, parking facilities, and any other reasonable privilege or benefit, whether major or minor—should be considered and provided within the division's budgetary limitations.

If group bargaining should develop, all supervisory personnel should proceed without hesitation to be most responsive with an attitude of honest, frank, friendly, and dignified negotiation.

Should formal negotiations be required, the university should employ a lawyer experienced in labor relations to negotiate the first contract. After a basic contract is properly negotiated it is probably advantageous for the university to delegate the Director of the Physical Plant Division to act as chief negotiating officer on future contract adjustments. If the Director is given this appointment, he must be thoroughly apprised of the university's position on all major issues to be discussed. The Director should consider adding a staff member with labor and industrial relations expe-

rience, because the actual "nuts and bolts" of bargaining must be done by one specially trained.

Throughout any negotiations, it is imperative that the Director keep the university administration posted on all developments during the negotiation period so that the university may rapidly react to the adjustments that will be required during the negotiations.

A rule of thumb that should be observed by the chief neogtiating officer is that, in so far as possible, he should attempt to steer all discussions towards points or areas of agreement and away from points or areas of conflict. Remember, the service which the Physical Plant Division furnishes is mainly produced by your work force. Thus, it is imperative that this work force is not only treated fairly, but that the work force knows it is treated fairly. Actions, both large and small, speak for themselves.

A few institutions, usually located in metropolitan areas and strong union centers, have formal agreements with the local unions for the building trades craftsmen employed in the Physical Plant Division. There are other institutions that recognize unions, pay the prevailing local wage rates, and observe the jurisdiction of the various crafts, although they do not have a formal agreement with the union.

The right of employees to organize and be represented collectively is recognized and accepted generally throughout the United States. On the other hand, the National Labor Relations Act "Taft-Hartley Law" does not apply to the state or its instrumentalities. Accordingly then, a public agency such as a State University cannot be compelled formally to recognize or bargain collectively with a union as the representative of its employees.

During these periods of rapid expansion of the physical plants, the Physical Plant Division will probably draw the majority of its skilled craftsmen from the union. Universities, generally, are notorious for the lack of in-service training for their nonacademic employees. Consequently, a physical plant division often has to rely upon the unions to obtain the skilled craftsmen that are required to carry out its functions.

The objectives of unions are directed toward the basic rate of pay, working conditions, the welfare of its members, maintaining standard efficiencies of its craftsmen, and the training of apprentices. There are usually two types of unions that might be related to a Physical Plant Division.

The craft's union is composed of skilled workers in a special trade, organized for their common welfare and benefit. They maintain apprentice training schools and require certain qualifications to become qualified craftsmen serving a particular trade. They elect a business manager or bargaining agent, who is invariably a qualified worker as well as being versed in the problems of the workers he represents.

An industrial union is a labor organization, either local or national, which accepts into its membership any or all workers of an industry regardless of job or title. They establish rules, regulations, and restrictions

to cover all job classifications from the common laborer to the most highly skilled worker in the plant.

There are many arrangements that can be negotiated between union and management in regard to a union shop. Some of the most common are:

Union Shop—Anyone, union or non-union, can be employed, but all employees must join the union after a specified time, and the union must accept all applicants.

Closed Shop—Only members in good standing with the union can be employed or hold jobs. Employers hire through the union.

Open Shop—Anyone can be employed and hold a job whether he belongs to its union or not.

Preferential Shop—The employer agrees to give union members preferential treatment under specified conditions. In case of layoffs, non-union employees go first.

Union Representative Shop—The union is recognized as the bargaining agent for all employees, both union and non-union. Employees are not required to join the union.

Percentage Shop—The employer agrees to keep a specified percentage of union members employed.

Obey one single maxim and it may avoid the need of a union or assist in employee negotiations with a union. The maxim: "Do unto others as you would have them do unto you."

COMMUNICATIONS

Physical Plant has the responsibility for either collaborating with a telephone company or with the operation of its own intra-campus system. In addition, Physical Plant may have a two-way radio system to control work vehicles and to use in coordinating traffic during special occasions on campus. The two-way radio system is an invaluable tool for the campus security forces during the off-hours, weekends, and holiday activities when the security force is the only official agent for the institution. This also involves a 24-hour watch by security on the Physical Plant switchboard, making it possible for emergencies to be reported and dealt with at all times.

SECURITY SERVICES

(Police and Fire)—It is recommended that the administration and operation of the security office be a function of the Physical Plant Division. The security office should be in charge of a chief or captain of security who would report directly to the Director or chief administrative official of the Division.

Police services should include policing, policemen, night watchmen, directing campus traffic and parking, manning of campus entrances and

the writing of parking tickets for parking violators, enforcing all laws and university rules and regulations, accident and crime investigations, and in some cases, provide ambulance service.

The security office is one of two most logical places for receiving, storing, and disposing of lost and found property. (The other logical place would be in the Student Union building and under the supervision of the Union management.)

The security office should cooperate very closely with all departments on the campus and with city, county, and state law enforcement agencies. In many cases the university security officers will be deputized by some or all of the three above named public agencies.

In order for the security office to perform its responsibilities in an efficient and legal manner it is necessary that the university study and adopt rules and regulations for the security office that are not only adequate but that are reasonable, enforceable, and that provide proper safeguards for the rights of all concerned, including the security officers.

Security office personnel might consist of both uniformed officers and civilian dressed investigators and night watchmen.

Many large schools have both uniformed police officers and night watchmen. Many of the smaller schools have only night watchman service.

Some schools have found it advantageous to employ private agencies to provide the necessary security.

Law enforcement may be achieved by a public police agency of a city, county, or a state. Sometimes policemen are deputized for campus patrol. A common trend among the large universities is to have their own police, with peace officer status through legislation.

Fire—In some cases the security office might also be responsible for fire and safety education, maintenance of campus fire fighting equipment, and work closely with the local fire department. Many of the new university complexes will include elaborate signal systems for fire alarm and night watchmen stations with automatic recording as to time and location of the alarm. These systems are quite complex but not expensive in the light of coverage that they give and the reduction in manpower effected.

Building codes and fire codes stipulate safety measures that must be observed in our buildings, but they do not prevent human carelessness. In addition to code compliance, the Physical Plant Division must include an active and continuous campaign against human carelessness which is frequently caused by ignorance as well as indifference. Prevention activities must be based primarily on adequate and formal inspection programs. These inspections must be formalized and scheduled on a regular basis, with pertinent records kept by floor and by room.

Fires will start despite every preventive effort. Fire insurance alone is not sufficient protection. Fire resistive construction is no guarantee against

loss of life or property. Once a fire has started, adequate fire protection demands the quickest possible sequence of detection, alarm, evacuation, and control as possible. Adequate fire protection may or may not be available from a public or community fire department. The decision to provide an on-campus fire brigade must be based primarily on an evaluation of the protection available from the public fire department.

The level of protection available in any political subdivision can usually be related directly to the capital investment within the community. If a fifty million dollar educational institution is located in a ten million dollar community, supplementary on-campus protection would probably be prudent.

Another evaluation which should be made is the type of protection available from the area adjacent to the campus. Fire protection for a campus can present some very complex and sophisticated problems, which would be foreign to a fire department which was oriented towards residential or forestry type protection.

Assistance in organizing programs for fire protection can be obtained from the State Fire Marshal, the Fire Insurance Inspection or Rating Bureau having jurisdiction in the area, and the local municipal or public fire department. A definite trend in recent years for assistance with this problem is the utilization of registered, professional, fire protection engineering consultants. No matter how the program is formulated; to be effective, authority must be granted to demand full cooperation from the staff, faculty, and students.

TRANSPORTATION SERVICES

The busy academic and extra curricular life of a university requires constant and often immediate moving of furniture, equipment, props, and countless other items. It is essential that the Division of Physical Plant be so organized as to provide this service promptly, carefully, and efficiently. Storage spaces, truck, and personnel are all required in this operation.

Just where this function is located in the organizational structure of Physical Plant is not as important as the fact that the service is available. In some divisions it is a part of the custodial operation. In some it is located in the grounds section. In others it is a separate transportation section. The size of the operation is entirely dependent upon the demands made for its services and will vary from school to school.

Transportation services should include the routine trucking services, special delivery services, garbage collection, campus patrol cars, etc.

Many schools operate a motor pool. Motor pool operations vary greatly. Some provide limited service and some are quite large with many types of motor vehicles available for use by university personnel. The motor pool is operated on a self-supporting or partially self-supporting basis with the money derived from rentals going to provide maintenance service and

replacement costs. Many schools are finding that they can replace their vehicles in from one to two years more economically than they can operate them for longer periods of time. The placing of all motor vehicles in a pool produces considerable flexibility and maintains better control over the use of the vehicles.

The motor pool is a logical function of Physical Plant and its operation might be closely related to the management and operation of the automotive repair shop.

UTILITIES

The Physical Plant Division is responsible for maintaining a complete file of record drawings on all physical facilities on campus, particularly those facilities relating to utilities buried underground. The long range planning of campus growth builds its skeletal framework with the buildings. The veins, arteries, and muscle are in its utilities systems. They must be continuous, must be adequate in size, and must be in excellent repair.

TRAINING

The demand is so great for skilled craftsmen, mechanics, and operating engineers that the Physical Plant Division must, by its very nature, carry on either a formal or informal training or apprenticeship program. This applies as well to the rapidly increasing need for operating engineers to handle the complex equipment in the modern buildings, especially in the fields of air conditioning, lab equipment, heating equipment, plumbing, and kitchen equipment.

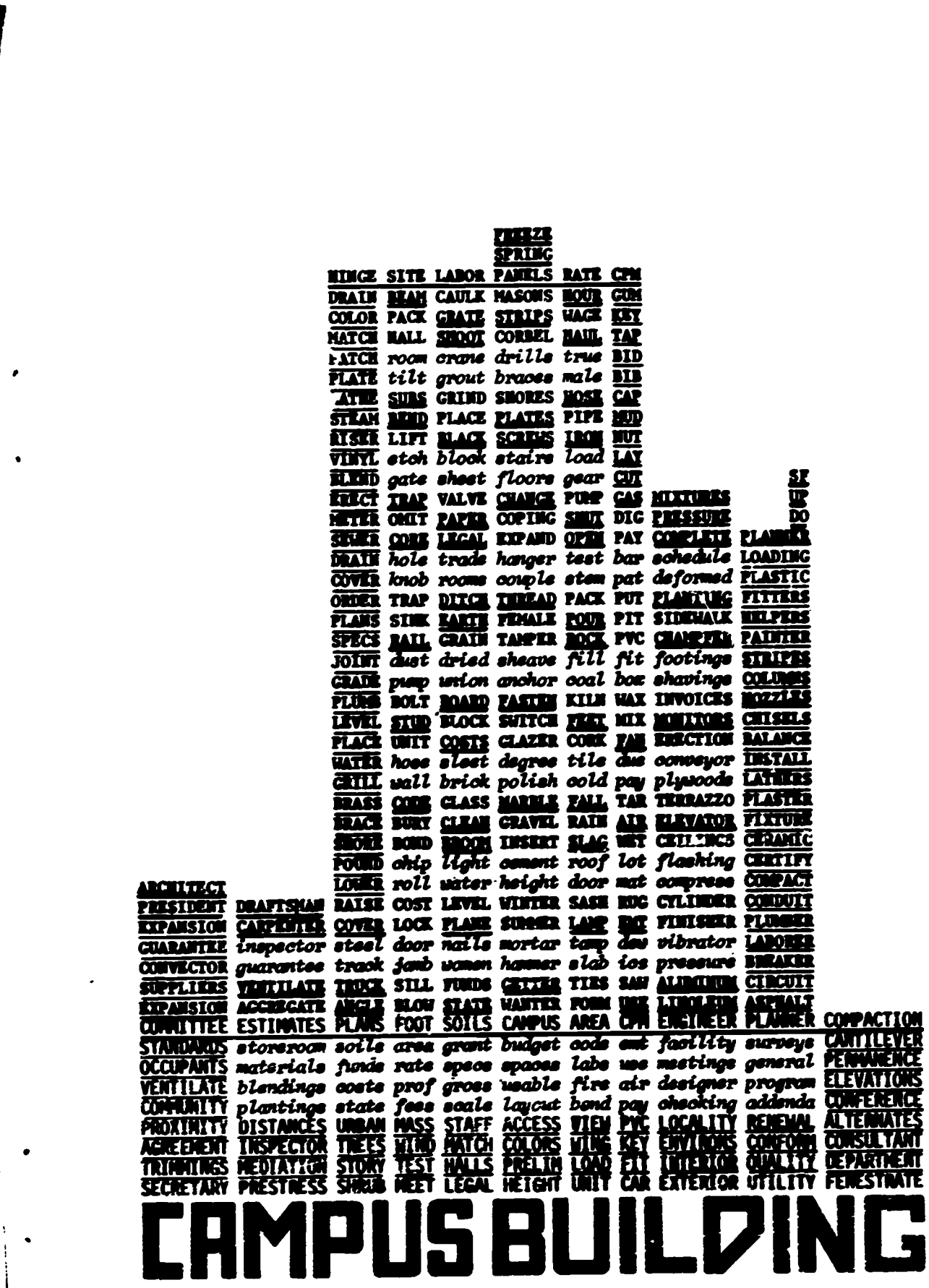
Most major manufacturers offer a short training course on their products, and the Physical Plant Director should encourage personnel to attend these courses. In most cases transportation, room and lodging are the only outlay. These training courses are especially valuable in operation and maintenance of air conditioning equipment, heating and cooling controls, servicing of specialized laboratory equipment such as sterilizers, centrifuges, pumps, motors, vacuum and air systems, etc. Housekeeping and custodial care training can be scheduled as on-the-job short courses with expert instruction in specialties from manufacturers' agents.

Chapter VI

CONCLUSION

The Physical Plant Division is staffed with career-minded people trained to do their particular jobs. The staff is available and welcomes the opportunity to discuss and consult with all members of the campus family on problems relating to the physical facilities. The Physical Plant staff's one goal and objective is to make possible the smooth functioning of facilities that will make the education process possible.

The most valuable adjunct to the Physical Plant Division is a competent, well trained, and well paid staff. Many institutions are short sighted in this respect and often find that they are a training ground for local industry and other institutions. The personnel office should make continuous surveys to determine proper wage scales, and the administration should be advised of the necessity of maintaining wages and other fringe benefits in order to stay in this highly competitive market.



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PROGRAMMING, PLANNING AND CONSTRUCTION OF COLLEGE AND UNIVERSITY BUILDINGS

Chapter 1

WHY?

It has been apparent for some time that the planning, construction, maintenance and operation of college and university physical facilities is big business. Where so much is involved it is good business to provide an organization and staff to do the best job possible in planning, building, and operation. An institution that is planning to spend millions of dollars in expansion can afford to provide an organization to see that projects are well conceived, well planned, and well built. The money necessary to provide such an organization could be lost or wasted on just one poorly planned or constructed building.

Architects have been criticized at times for their shortcomings in connection with their work on college and university buildings. All of us have had experiences which have at times made us critical of the profession. However, a goodly share of the fault lies with the institutions. In too many cases too much responsibility is given to the architect and not enough responsibility is assumed by the school. In too many cases the architect is not given the information necessary to design a building to properly serve the functions that will be housed there. (This is the fault of the school.) In too many cases the staff and operating personnel are not given the opportunity, or sufficient time, to properly review preliminary drawings before the architect is authorized to proceed with working drawings. (This is the fault of the school and can, and will, result in many needless, costly mistakes.) In too many cases final plans are put out to bid without careful checking by qualified university personnel. (This is the fault of the school.) A set of working drawings can be greatly improved by a careful prebidding review by the technicians in the Division of Physical Plant and by other directly interested university personnel.

The architect does some truly wonderful things. However, an architect should be given a carefully worked out program of requirements to review before he signs the contract. His work and progress should be carefully reviewed at proper times during the planning stages by qualified university personnel. The school should get what it wants and needs with the considerable help of the architect, and not largely what the architect feels the school should have. This places a lot of responsibility on the school because intelligent programming, critiques, and architectural and contractual assistance are the result of organization and proper use of qualified staff.

In 1963 a survey[3] was made of 207 small, medium, and large colleges and universities throughout the United States and Canada. These schools

[3] "Organizations and Functions of Physical Plant Departments of Universities and Colleges." Sam F. Brewster, Director of Physical Plant, Brigham Young University—1959.

constructed over 206,000,000 square feet of space between 1950 and 1963. These same schools expect to build 172,000,000 additional square feet of space by 1970. Multiply these figures by the arbitrary but conservative figure of $20 per square foot and it becomes immediately apparent that where so much money is involved the very best organization possible is needed.

Of the 207 schools included in the survey the physical plant divisions in 34% of the larger schools and in 15% of the smaller schools had the responsibility for programming requirements and giving instructions to architects. Many of the 207 schools have physical plant divisions that, while not directly responsible, are consulted on planning matters. However, 16% of all of the physical plant divisions indicated that they are not consulted about architectural matters and have little or nothing to do with establishing building needs. Thirty-one percent of the physical plant divisions of the 207 schools feel that they could make a bigger contribution to the planning of new facilities if given the opportunity. Twenty-four percent of these same physical plant divisions feel that they could make a larger contribution to construction if the opportunity were provided.

It is interesting to note that 50% of the group contacted felt that their divisions of physical plant could render a real service if organized, staffed, and given the opportunity to supervise planning, construction, and maintenance and operation at their respective schools.

There it is! The division which should be best prepared, and would seemingly be the most logical one to be given great responsibility for matters dealing with planning and building, is in many cases not being utilized in this connection to any great extent. There are undoubtedly good reasons why this is so, but there are also many good reasons why this should not be so. It seems essential that the people who are to use a building and the people who must maintain and operate it be given every opportunity to assist in planning the facility, and in the case of maintaining and operating it, the opportunity to assist in its construction.

Some schools require their operating and maintenance personnel and the using personnel to review all preliminary and working drawings and specifications before they are approved by the school. In some cases many typewritten pages of mistakes, lack of coordination between the architect and the associated engineers, etc., etc., are assembled from the comments and observations of the numerous specialists who, upon completion of the project, either will use it or operate it. Some of these comments and observations by so many people are duplications and some are not valid criticisms, but it is amazing how many are valid and how thankful everyone, including the architect, is that these mistakes were caught on paper rather than after they were put into concrete and steel. There is too much money involved in present-day construction, and in maintenance, to not utilize every possible precaution to ascertain that the plans being bought are what is wanted and needed.

Obviously each school will handle its planning and construction problems somewhat differently from any other school. Local conditions, pre-

cedent, existing personnel, available personnel, size of operation, type of school and other varying factors all influence the type of organization finally put together to get the job done. It is not intended, therefore, that the following statements should be construed as final and absolute. The items listed are considered necessary to a successful building program. How they are administered and by whom will continue to vary from school to school. Each school, however, should make every effort to effect an organization to make the best use of its own staff and that of professional planners commissioned to work on specific projects. No effort is made to indicate a typical or preferred organizational chart. Likewise, the following items are not necessarily listed in their order of importance or in the order in which they would be done. It is recommended that each item be seriously considered as something worth doing, if not already being done in a better way, and that all be worked into the type of organization that best suits each individual school.

Chapter II

THE ACADEMIC PLAN

In developing a long-range campus development plan the hardest item to come by, and usually the last, is a statement of the objectives of the institution; i.e., its academic plan. It is difficult to make much progress in physical planning without an academic plan. The objectives of physical planning are to make possible the achievement of the academic goals. Campus planning must then start with an academic plan.

The first requirement of an academic plan is a definition of the role of a particular institution in the system of higher education in its state. Each segment of higher education in junior colleges, state colleges, state universities, and private universities must be considered in projecting enrollment for a particular state. The allocations to the particular institution should be clearly defined so that they can be used as a planning base with confidence.

A complete academic master plan will include brief individual plans for all academic departments as well as plans for all administrative and operational departments. It is essential that the respective disciplines on the campus be defined. The ones that are going to be pressed for rapid growth or improved quality must be noted. The extent of the pressure for new schools or large additions of space demanded by disciplines must be taken into consideration.

Having determined or assumed certain basic programs and policies, official tabulations of projected student loads and related number of faculty and staff in each department within each school or college can then be made. With this information, preliminary physical campus planning can begin. An official tabulation of student and faculty projections is really quite difficult to obtain, especially if it is projected forward on five or ten-year intervals. In order to do this, planners must study all of the records available on past enrollments. Someone must set the total enrollment that can be handled on these future projected dates; therefore, it is necessary to start with the answer and literally work backward. For instance, what will be the projected student mix—i.e., lower division, upper division, graduate division? After establishing an estimated total enrollment it is possible to determine projected enrollment for colleges and schools and eventually departments.

Good academic planning requires each departmental program to be described in terms that can be translated directly into quantitative measurements of proposed teaching, research, and administrative activities and of the physical facilities estimated to be required by the proposed activities. An ideal educational program would define all the way down to a curricu-

lum plan which should include courses to be offered and for each course a total enrollment, student credit hours, desired number and type and size of sections, and the number of weekly laboratories and/or scientific laboratory hours for each section.

Faculty and staff needs are directly related to student enrollment. The staff must be appointed in areas where students take their course, and these are not necessarily in the colleges and schools where the students are enrolled. Overall campus needs, however, can be gauged from student projections using faculty-student ratio such as one to sixteen, and a teaching staff-student ratio such as one to twelve. This type of information is important for physical planning.

At some future date the general campus should be the result of a normal orderly development from its present configuration. Consideration must be given to related bureaus, institutes, and centers that will then be on the campus. There should be some indication of the type of methods of education and research that will be used at that particular time as compared with the traditional methods of today.

The library as the heart of an intellectual center must grow continually in order to strengthen a campus. Consequently, the size of the library in regard to the volumes of books that it should have should be depicted. Moreover, the graduate division is becoming more and more important, and the disciplines that will offer master's and Ph.D.'s should be indicated. Sites should be reserved for these future developments. Physical needs should be taken into consideration, and the physical plan should be flexible enough to allow for the incorporation of these facilities at a later date.

A rapidly expanding institution will affect the campus in many ways other than in its academic field. The friendly spirit that has prevailed on a small campus may no longer be possible as it becomes large. The expansion of housing for single students, and possibly additional housing for married students, especially if the university increases its role in graduate work, will have a definite impact upon the lives on the campus. It probably will be difficult to visualize completely how many more extracurricular activities will arise as the student body doubles and quadruples. This definitely will increase the needs for social as well as cultural activities. It is difficult to maintain even casual acquaintances with new faculty colleagues on a campus that is rapidly expanding with more specialized new schools and new curriculum, as well as powerful tendencies, to segment old courses and invent new courses.

Another development associated with expansion generally, but with graduate work particularly, is the increase in postdoctoral scholars who wish to finish their training or take part in cooperative research programs. This becomes important and space needs must be recognized and planned for. Some campuses already are moving to a three-term academic calendar. Undoubtedly, other campuses will follow this pattern. The necessity of providing air conditioning for teaching and laboratory facilities in order to make possible year-around use should be emphasized.

Chapter III

THE MASTER OR CAMPUS PLAN

Preparing a comprehensive plan for the development of a new institution or for the development of an old institution on a new site is easy compared with developing one for an institution that has grown without benefit of long-range thinking and planning. Even in the worst cases, however, it is not too late to start. Very definite progress can be made, in a few years, when campus development begins to follow a predetermined plan.

The campus master plan should be prepared by architects, landscape architects, or planners who have had good professional training and who have acquired considerable knowledge of the academic and auxiliary requirements which, taken together, establish the basis for the plan. Such planners must spend the time necessary to thoroughly understand the academic plan and the possible future growth pattern of the school. The master plan should largely be a concept or philosophy. Such a plan should not be lightly adopted and once approved it should not be lightly ignored or set aside. Detail planning should follow the large-scale comprehensive plan, and in order to obtain the best results there should be a predetermined scheme of things.

The master plan should be in the office of the chief campus planner and in the meeting room of the campus planning committee, and should be the basis of most discussions pertaining to the development of the physical plant. Experience has shown that a master plan needs to be restudied, revised, and redrawn every few years. In this way the plan will always reflect the latest thinking, but the basic and important original concept should still be dominant.

Chapter IV

SPACE STANDARDS

Space standards and utilizations in recent years have been the object of a great deal of study and discussion, and volumes have been written on this subject. This is commendable. Projections of physical needs in plans are only as reliable as the space standards are realistic and appropriate to a particular institution. Consequently, standards for space and utilization must be established and accepted after they have been tested on the campus. It is impossible to keep physical planning current if changes are being made in the standards for office space, graduate student research space, contract research space, and the like.

An up-to-date physical plant inventory of space and its utilization is a must if the physical facilities are to be used efficiently. The campus officer (not Physical Plant) assigned responsibility for controlling space assignment and utilization should have for each building information regarding the capacity, the occupancy, and the utilization schedule of each room. This data should be on a perpetual inventory and should be studied continually for a better utilization of space. A chief campus officer (President or Chancellor) must make the important decision on the relative merits of utilizing and expanding the present plant versus new buildings and new facilities. In a period of belt-tightening, certain departments can show an amazing ingenuity for utilizing space within present assignment, while other departments will only complain about the situation.

When appropriate standards for the institution have been decided upon, as well as how much classrooms and laboratories will be used, the total needs of a campus in terms of buildings and land can be determined with some degree of accuracy.

Chapter V

PROGRAMMING IMPROVEMENT PROJECTS

There are thousands of architectural firms in this country. Many of them possess the skill, artistic judgment, and technical know-how to design university structures. The same is true of electrical, mechanical, and structural engineers. The problem is to design structures that will serve adequately the complex uses which will be made of the many components of the buildings.

No matter how good the architect or engineer may be, he cannot know, and should not be expected to know, how to plan a building to serve a large number of specialists without considerable help and assistance from the "specialists-clients" themselves. Thus, the real problem is how to transmit literally hundreds of messages from the university staff to the architect, conveying the staff's wishes, needs, likes and dislikes, interests, theories, problems, and a multitude of other items in such a way that these items eventually can be translated satisfactorily into concrete and steel.

There are various ways of working with the architect during the important early planning stages. A method which too often is used is to have the architect talk to a score of people, making notes and asking questions until he begins to "get the picture." Then he prepares a plan and a picture (perspective) beautifully delineated in color and mounted in a frame. Armed with this, he then tries to sell his creation, pointing out all of its good points. The bad feature of this method is that the owner may end up with a beautiful building, but one that is almost totally lacking in its attention to those details that will become so imporant starting with the day the building is occupied.

Another method is for the owner, where the talent is available, to produce sketches and drawings of what is wanted, to give to the architect. This method has a tendency to freeze thinking and to force the architect into adopting predetermined forms and shapes. Also, such a method has the disadvantage of still not giving to the architect as much information as he should have on scores of details. Even so, sketches and drawings used to supplement a written program do have merit.

Another method is for the owner to prepare a written program, working through an ad hoc project committee and the campus planning committee. This program can, and often is, prepared before the architect is selected. Here attention should not be given so much to the shape or form that the building will take, but more to the size, use, special requirements, and special features desired in the various components that, taken together, will form the building. This means that those working on such a program must know how they intend to use the building and for what purpose. Having

to prepare a detailed written program, in advance of plans, has a good effect on the future users of the building. In order to get approval of their proposals they must have clearly in mind how they intend to use their future facilities. This organization of thought and procedures makes for better teaching and research.

When a preliminary written program has been prepared by the joint efforts of a Project Committee, the Campus Planning Committee, and the Planning Department of the school, it should be discussed in detail with the President of the University and with his Administrative Council. It is here that policy questions are finally resolved and a University-wide acceptance of the project is obtained. After this meeting, or meetings, final changes and corrections are made, and the written program is bound in sufficient copies that everyone interested may have a copy.

By having such information at the very beginning of a project, the architect can start to work immediately. By not having to spend so much time attempting to dig out this information for himself, he can spend more time on his schematic drawings and can therefore give the owner more different schemes to study and to choose from.

To do satisfactory and worthwhile programming there must be a person or persons in the planning office of the school who are trained in the technique of programming and who can work closely with the project committee to produce documents that reflect the desires and needs of the future users in such a way.

Chapter VI

INSTRUCTIONS TO ARCHITECTS AND ENGINEERS

To supplement the written programs it is recommended that a manual of instructions to architects and engineers be prepared. This manual should contain information that is largely applicable to any major construction project being planned for the university. It should contain any special forms and proceedings the school wants used. It should contain technical information and sketches, where needed, on items that the school has standardized on. This will save considerable time because it will not need to be written into each new program as it is prepared. Such a manual will quite likely be small when first started, but over the years it will be revised and added to until it will become quite sizable and *very valuable*.

Chapter VII

FIELD TRIPS

Some of the best money that can be spent during the latter stages of programming and after the architect is generally acquainted with the needs can be spent on field trips. Like most things, these have to be organized and done carefully if full value is to be realized. Too many trips do not produce because they are largely sightseeing excursions.

The practice of academic staff members taking trips months and sometimes years in advance of planning under the guise of finding out what is needed in "our new building" is not recommended. If such a trip is approved there should be a very strong and special reason. The best time to go is after the program is fairly well established and the architect has been briefed, but before he starts sketches and before the written program is finally completed and approved.

Just to go and look is not sufficient. Before the field party leaves on the trip, a written check list should be prepared listing the items that are of principal concern and interest. The same information should be recorded at each facility visited. Only by asking the same questions at several places and later comparing the answers can a true picture be formed of what is best to do. Immediately upon return to home base all of the check lists should be edited and put into an indexed folder for easy, quick reference. The old adage about a picture being worth more than words is certainly true in cases of this kind. Two cameras are recommended—one loaded with slow film for outside work and one loaded with very fast film for inside work. Almost any inside detail can be photographed well enough without tripod and flash if fast film is used.

It is recommended that the field party consist of the chief planning official of the school, the Director or appropriate individual of Physical Plant, the person doing the programming, the chairman of the ad hoc project committee, and the architect. Such a field trip and report, if properly done, will provide invaluable information on what to do and often of equal importance, on what not to do.

Chapter VIII

TOPOGRAPHIC SURVEY AND SOIL TESTS

TOPOGRAPHIC SURVEY

Too much detail is not required in this discussion of a topographic survey, because most everyone is familiar with a topographic map and its use. A topographic map, to be helpful to the architect and his engineering associates, can become a fairly complex drawing within itself. Not only should it contain all information concerning surface features, but it also should include those underground features that will have an influence on design. Normally a good topo will contain and clearly show the following: ground elevations or contours; bench marks; grid system properly referenced; property lines or contract limit lines; trees and other natural features; structures: utilities with sizes and characteristics, and especially invert flow line elevations; manholes, and any other features or items that should be known by the planners. It is not, of course, enough merely to indicate a sanitary sewer. The size of pipe and direction of flow should be shown and grades taken at the flow line in all manholes so that depth of sewer may be determined. If there are special places at which connections should be made, that information should be shown. Similar information should be shown on all utilities both underground and overhead. All work should be coordinated with the local municipality so that design of the project does not overload sanitary sewers, storm sewers, power, and other utility lines which might make last-minute changes expensive.

Topographic surveys may be made by professional civil engineers working under contract with the school, or if the school has sufficient work it will probably be more economical and desirable to employ a professional civil engineer on a permanent basis and supply him with equipment and additional personnel as needed.

SOIL TESTS

Soil tests are another planning tool normally furnished architects at the time they are ready to start work. This is particularly important if the subsurface of the campus is uncertain and unpredictable. It is generally better to furnish the architect with a preliminary report on foundation investigation at the beginning; later the architect and his structural engineer indicate the amount and kind of additional information needed for design analysis.

These tests consist of holes drilled on the proposed site at depths generally ranging from forty to one hundred twenty-five feet. The borings indicate the type of material, its location, and its thickness. From the cor-

ings tests are performed to determine the bearing capacity both with respect to shear failure and differential settlement. Special attention is given to water problems and especially to the possible loss of bearing capacity due to artesian conditions.

Final bearing capacities and foundation recommendations generally follow the determination of the preliminary design by the architect, and are worked out by close cooperation between the architect, the structural engineer, and the soil engineers.

The cost of the soil testing and engineering is generally borne by the university and is not included as a part of the architect's fee.

Chapter IX

COMMITTEES

CAMPUS PLANNING COMMITTEE

The campus planning committee should be a permanent advisory committee appointed by the president. The committee should be thoroughly briefed on the long-range concepts of the university and should be comprised of capable school officials whose judgment and recommendations would be given serious consideration by the president and by the board of trustees. Deans, directors, and department chairman should meet with this committee and discuss their building problems. Through this system of reviews and discussions, committee members would become very familiar with the space requirements of the university. The campus planning committee would thus exert a large amount of influence over individual project committees as to building sizes, extent of development, and cost of projects.

The committee should review all building programs and meet with the president and his administrative council for discussion of the proposals and for determination or clarification on policy matters. The committee should review all plans submitted by architects and engineers and, when satisfied with the plans, recommend to the president that they be accepted. The director of the Division of Physical Plant and the chief fiscal officer of the university should very definitely be members of this committee. It is recommended that the committee consist of not less than five members or more than seven members. It is further recommended that the campus planning committee not become involved in a mass of daily operational problems, but devote itself to major planning and capital improvement projects.

PROJECT COMMITTEES

Individual project committees are essential in planning major buildings. These ad hoc committees are not to be confused with the campus planning committee. A project committee, which may be comprised of from five to seven persons, should be appointed for each building that is to be planned. But the campus planning committee works with all project committees. Project committees, working with the campus planning committee and with the planning office of the school, determine the many items required on each project and assemble them into written programs. It is this committee's responsibility and duty to work with all present users of the project to see that everyone's needs and desires are properly presented to the school planning office and to the campus planning committee. Once the architect on a project starts to work, the project committee works

closely with the campus planning committee in reviewing the work developed by the architect and by the university personnel responsible for planning. After plans are well developed the project committee has less frequent contact with the planners, but is available when needed. During construction of the building, the project committee works with the university purchasing department in selecting furniture and equipment. As soon as the building is accepted and occupied, the project committee for that particular building is dissolved.

Chapter X

PLAN SUBMISSIONS

As part of the planning process it is recommended that each architect be required to submit his work to the university for review and criticism at three principal stages: schematics, preliminary drawings, and working drawings. Each architect should be required to submit his schematic drawings in accordance with the owner's program requirements. During this preparation the architect should be encouraged to make several studies of the problem in an effort to arrive at a solution satisfactory to him and to the university. Frequent consultations by the architect with the university during this important phase of the work are essential until a general acceptance of one scheme is obtained. The architect's drawings may be single lined if he desires, and elevations and perspectives at this stage are not required, but the architect is encouraged to make a sufficient study of the arrangement of building masses to depict the general architectural concept of the project. The architect should be required to show on the main floor plan tabulation of space areas shown on his schematics as compared with those shown in the owner's "Program Requirements." The architect should furnish copies of the schematics to the university. (These are used for checking purposes by the Physical Plant and by the future users of the building.) He should be advised in writing as to the required revisions or official approval. Until written approval is received, the architect should not be authorized to proceed with the preliminary drawings.

After the architect has received approval of his schematics by the university, he can proceed with his preliminary drawings. At this stage the architect prepares floor plans, elevations, and cross sections, as a further development of the approved schematics, and he does this in sufficient detail to show clearly the nature, size, and architectural concept of the project. He should also prepare an outline specification in which the general type of materials and equipment for each trade classification is shown. In addition, the architect should submit a carefully prepared preliminary estimate of cost. He should also include on the main floor plan a tabulation of space areas shown on the preliminaries compared with those previously shown on the approved schematics. In addition, he should furnish to the university one framed perspective and the required number of copies of the outline specifications and all copies of all drawings (for checking purposes). The architect should be advised in writing of any required revisions or approval. He should not be authorized to proceed with working drawings until he has received written approval of his preliminary drawings.

After the architect has received approval from the university on his preliminary plans, he may proceed with the working drawings. He should

prepare these drawings and specifications in harmony with the approved preliminaries and the university's statement of "Instructions to Architects and Engineers." He also must design structural features in accordance with the local building code or follow the recommendations of the Uniform Building Code, latest edition. The architect is instructed that the specifications should be so written that each trade classification may be bid separately and that open competitive bidding may be had on all items. He should confer with the university on instructions to bidders, form of proposal, performance and payment bond, form of contract payment, general conditions, and general scope of work. The architect should be reminded to be especially careful during this stage in coordinating the structural, mechanical, and electrical designs with the architectural plans.

When the drawings and specifications are substantially completed, the architect should submit to the university copies for checking purposes, accompanied by a letter of transmittal. Marked check sets and written suggestions should be returned to the architect for any necessary revisions. After the revisions have been made, the plans should again be returned to the university for a final review. When the plans have been approved, the time and place for opening the bids are determined, and the architect completes this phase of his specifications. The specifications are bound, and the project is ready to be put out for bids.

Plan checking at all stages by Physical Plant and other appropriate university personnel is so important that it is recommended that a check list of those who should review plans be used. When a set of plans is received, they should be placed in an accessible spot and the check sheet should be marked and sent to all who should check that particular set of plans. The check list should state that a written report of any criticism, discrepancy, or recommendations should be submitted to a certain individual by not later than a certain date. This certain person should edit all comments and put them into one report, which should be given to the architect. After the architect and his engineers have had a chance to review the comments, a meeting should be held where final agreements are reached.

Chapter XI

CONTRACTS

BIDDING PROCEDURES

Oftentimes a private school has more freedom in taking bids than does a public institution. When possible it is recommended that general contractors be prequalified. Briefly, this is how it works. A "Contractors' Application for Prequalification" form is developed in such a way that when all of the questions have been answered and all statements made, the university has a complete record of the experience, capabilities, organization, and financial condition of the company. Contractors would be approved for different-sized jobs depending on their capabilities. When a job is ready to bid, invitations would be limited to those firms who are prequalified for size of job to be let. It is not often that subcontractors are prequalified, but the idea has merit, because on many large jobs the bulk of the work is done by subcontractors.

Most, if not all, of the state institutions cannot exercise so much freedom in selecting their bidders. Generally the procedure is to advertise in local and state papers a minimum of three times at one week intervals. In this case the owner has little or no control over who can bid, and is required to award the contract to the low bidder, unless the contractor's situation is so bad, and so apparent to all, that an exception is granted by some state or governing agency. The contracting business today is big business. Fortunately the industry has done much to police its own ranks and to require its members to maintain high professional standards. The Bureau of Contract Information, Inc., Tower Building, Washington 5, D. C., accumulates, compiles, and makes available information concerning the records of responsibility and contract performance of every general contractor in the United States.

There is always the possibility that a successful bidder on a project will use one subcontractor's price in putting his bid together, and when he gets the job will contact other subcontractors to see if one of them will cut his price and do it for less money. These savings, never passed on to the owner, sometimes result in trouble because a subcontractor may take the job at too low a price and either default or try to skimp or cut corners on the job. If a school has this problem it should try to devise a system to prevent this "shopping around." One solution is to require that each bidder state the name of specified sub-contractors or the brand of equipment proposed. The university may reject a proposed subcontractor before awarding the contract.

AWARDING THE CONTRACT

Once a successful bidder has been determined and negotiations, if any,

have been concluded, it is time to prepare a contract. The construction contract spells out the agreed upon price and any special conditions, if any. It generally lists all of the plans and bid documents. It normally sets the completion dates and where bonuses and liquidated damages are used it details the agreements and terms. The contract normally contains a statement about the owner supplying storage space, and about the contractor not being an agent of the owner. It is desirable to have a section designating who the owner's representative will be and another designating the contractor's authorized agent. It is also well to have a section dealing with inspection–spelling out who will do it and what it obligates.

When the contract has been signed, a cooperative team effort commences. The contractor, the architect, and the owner must each know his business and his responsibilities and be prepared to cooperate and to work together harmoniously. The prime mover toward harmony and good relations would be for all three parties to meet their obligations on time. In most cases the owner has no contractual relationship with subcontractors or material suppliers; therefore, the contact should be through the general contractor. Although the owner enjoys certain rights with respect to the conduct of the work, he cannot issue direct instructions as to the methods or procedures or unreasonably interfere with construction operations. As one might expect from the contract document, prepared especially for the owner, the contractor has few rights and many obligations under the contract. The contractor is expected to give his personal attention to the conduct of the work. The contractor is responsible for his interpretations of the contract document and guarantees all materials and workmanship as put into place, both by his own forces and those of his subcontractors. The contractor is obviously liable for damages to property and for injury to persons caused by his negligence or carelessness.

Chapter XII

INSPECTION AND SUPERVISION

The architect's services during construction might include regular supervision, limited supervision, consulting services, or no services at all. Regular supervision makes the architect responsible for almost everything, including the issuance of monthly estimates, issuance of change orders, and other things required to keep the job running smoothly. For this service the architect is normally paid from one and one-half percent to three percent of the contract amount, depending on the size of the project and the amount of his basic architectural fee. Under this arrangement the architect is definitely the owner's representative, and he relieves the owner of much responsibility as well as the necessity of providing an organization to handle the paperwork and most of the on-the-job inspections. This is a good arrangement for a school that does not have strong, well-organized planning and construction offices.

Limited supervision relieves the architect of just about all of the responsibility during construction, other than a minimum number of visits during construction; checking shop drawings; and furnishing interpretations and services necessary for the proper execution of his work, such as selection of colors, textures, and finishes. This requires the school to be staffed with either an engineer, office help and building inspectors, or an architect with the same staff. Such a system throws considerable responsibility on the school but has much to recommend it.

Under consulting services the architect would normally furnish interpretations as indicated above and would either issue or approve change orders which alter the function, quality, appearance or cost of the finished work. Any other requested services, unless previously agreed to, would be paid for by the owner.

Whatever system is used, arrangements should be made for the owner to secure "as-built" drawings when a project is completed. Normally this is accomplished by having the general contractor furnish the architect with complete information on all plan changes. The architect makes the necessary changes to his drawings and supplies the owner with microfilm reproductions, reproducible tracings, prints, or whatever the owner prefers.

When a project is nearly complete, the contractor will request a "final inspection." Representatives of the contractor, the architect, and personnel from the school conduct these final inspections. A "punch list" of items not acceptable or not completed is made. These punch lists often are many pages in length, depending on the size and complexity of the project. Final inspections are extremely important and should never be hurried or taken lightly.

It is recommended that five or ten percent of the contract amount be retained until all punch-list items are completed and the project is acceptable. At that time a letter is written to the contractor officially accepting the project as of a certain date. The contractor is then paid in full, and his period of guarantee or workmanship and materials commences on the date of acceptance.

Chapter XIII

ARCHITECTURAL APPOINTMENTS

Several systems are used by colleges and universities in this country to secure their building plans. Some states have central planning offices and do all or most of the architectural work for their schools. Some schools have their own architectural offices and do all or most of their own planning. Some schools will use only one professional firm of independent architects and that firm does all of the school's work. Some schools use several firms of architects and thus pass the work around. Other schools use combinations of the above systems.

Whatever system is used, an architectural firm should not be employed without first checking carefully its professional qualifications and the firm's desire to cooperate fully with the school. Also, everything else being equal, the architectural firm that has had success in planning a building of like function to the one being considered has a long start over an equally good firm which has had no experience with that type of building.

Size of a firm does not always indicate architectural excellence. Many splendid architects prefer to keep their offices small in order to be able to give their personal attention to their work.

Today's modern college buildings are much more complex than were their counterparts of a few years ago. In some buildings the electrical and mechanical cost will amount to from twenty-five to forty percent of the total cost of the structure. Thus, it becomes very important to know who the architect's engineering associates are going to be. Over the years more problems, and expensive ones at that, will develop in the mechanical and electrical systems than are likely to occur in the rest of the building. It is therefore recommended that the owner find out from the architect, before a contract is signed, whom he proposes to use as his mechanical, electrical and structural engineers. These firms should be just as acceptable to the school as is the architect. If they are not, understandings should be had before the contract is signed.

Chapter XIV

RECOMMENDATIONS

The following are a few points that are recommended for serious consideration by universities and colleges:

1. That a growing school should maintain a strong central Planning Office, preferably in the Division of Physical Plant. If it is not located in Physical Plant, the strongest possible liaison should be maintained between the Planning Office and Physical Plant. In any case the Planning Office should be adequately manned with competent personnel and should be the center of all campus planning.

2. That just as much care should be given to the selection of the structural, mechanical, and electrical engineers as to the architects. Mechanical and electrical work comprise from twenty-five to forty percent of the cost of modern university buildings.

3. That each architect should be given the following carefully prepared items very shortly after signing a contract, and before he does any planning:

   (a) A written program of requirements.

   (b) Instructions to supplement the written program. These instructions should present information to the architect on the details that the school has standardized and that are common to nearly all projects.

   (c) A carefully prepared, comprehensive topographic map.

   (d) A preliminary investigation of, and report on, foundation conditions at the project site. (This may not be needed at many schools.)

   (e) A "Field Trip Report" complete with text and pictures, This report would cover the trip of the architect and school personnel to see and inspect similar projects at other schools.

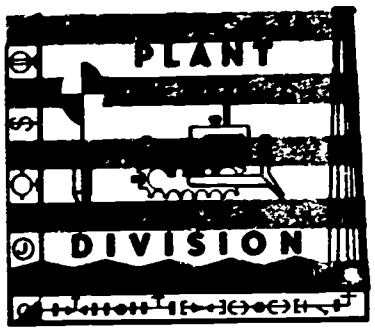
4. That whenever possible general contractors should be prequalified, and the owner should reserve the right to approve or disapprove any subcontractors proposed by a general contractor. (It is realized that this will be difficult, if not impossible, to do in many cases.)

5. That every supervisor and foreman in the Division of Physical Plant and every member of each project committee should be required to review both preliminary drawings and working drawings and specifications; and to give his comments and recommendations in

writing to one person for compiling and editing, and for transmittal to the architect.

6. That the Campus Planning Committee should be advisory only, limit its activities to major projects, and not become involved in routine operational and maintenance matters.

7. That the school should maintain adequate, competent building inspectors. These building inspectors should be on the job whenever the contractor or his subcontractors are working. If this work is not done under the supervision of the Division of Physical Plant, some method should be devised to use the many skills possessed by Physical Plant personnel.



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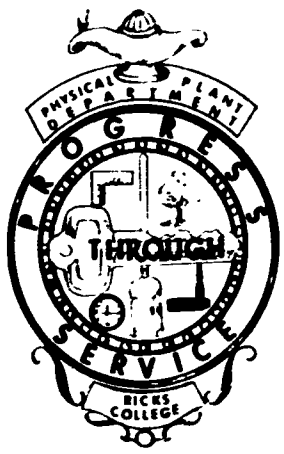

RICKS COLLEGE

NAPPA

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UNIVERSITY

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MAINE

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