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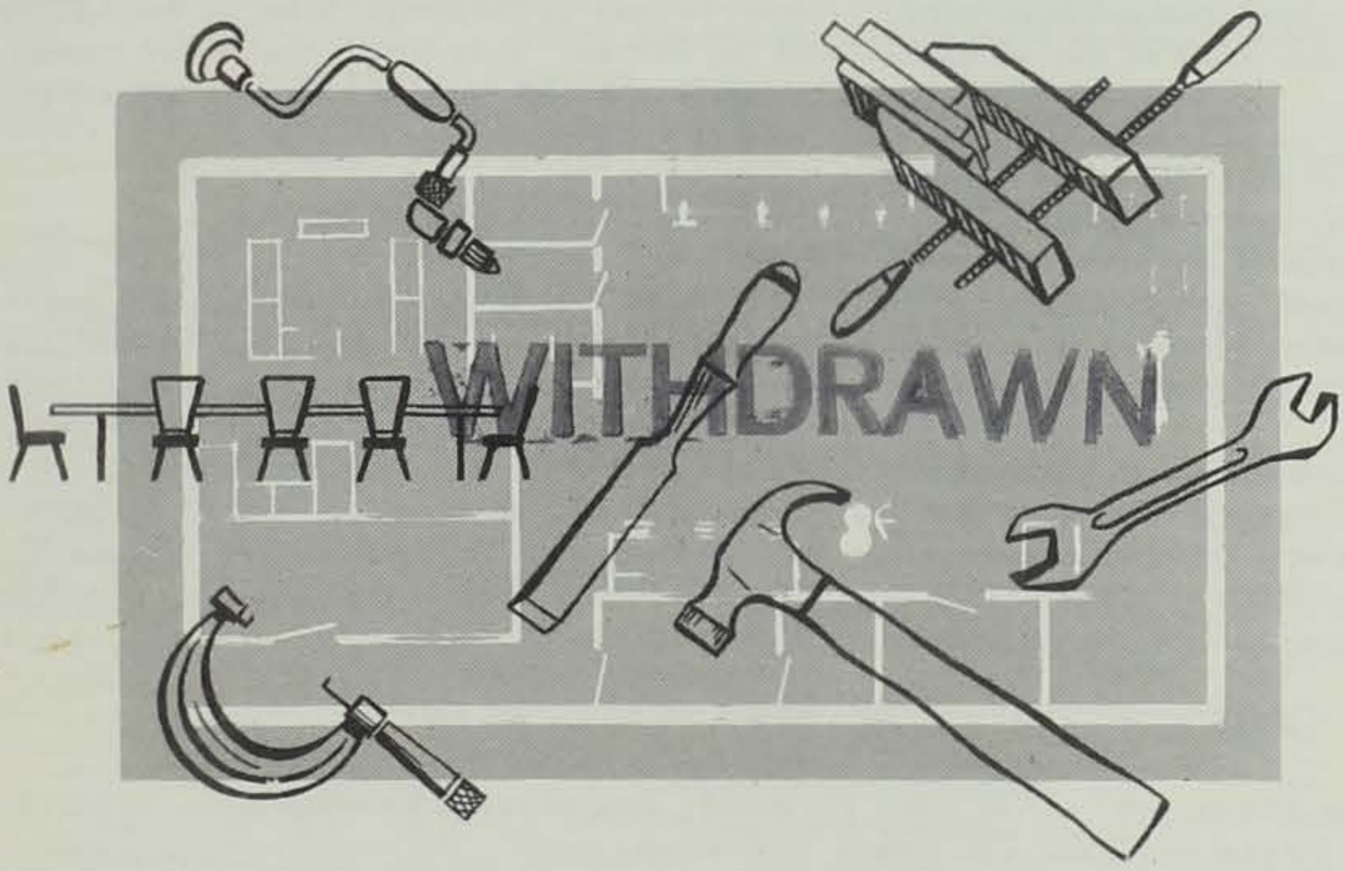
SCHOOL BUILDING PLANNING SERIES

A GUIDE FOR PLANNING SPECIALIZED DEPARTMENTS FOR HIGH SCHOOLS IN IOWA



WITHDRAWN

INDUSTRIAL ARTS

Bulletin 127–3

Engineering Extension
Iowa State College
Ames, Iowa

PREFACE

One of the major tasks of local boards of education is that of providing adequate housing for rapidly increasing school enrollments. Those responsible for school planning must be informed on trends in education and their implications for the future, and must use all help available in securing the most efficient plant in the light of community needs.

The American Association of School Administrators in their 27th year-book suggest the following:

Curriculum Adequacy — Does the building provide the space and facilities for the educational program needed by the children, youth, and adults of the community?

Safety and Well-being — Does the building provide a positive influence for improving the health and physical welfare of the pupils?

Interfunctional Coordination — Is the building so planned that the activity in each part may be coordinated harmoniously with related activities, without disturbing other activities of the school program?

Efficiency and Utility — Is the building so planned that the handling of materials and the passing of pupils, school staff, and the public are accomplished with a minimum of interference and a maximum of ease and satisfaction to all concerned?

Beauty — Is the building pleasing in appearance with simplicity and usefulness as the major objective?

Adaptability — Is the building so planned that it can be enlarged or rearranged internally to meet new educational demands at a minimum cost?

Economy — Is the building so planned that in original outlay and future operation the utmost in educational utility can be secured for every dollar spent?

The local board of education is the basic policy making body for planning and promoting educational programs and buildings. The superintendent, as a trained educator, is the chief executive officer for the board, and assists by preparing recommendations based on careful research. The teachers, as the personnel closest to the pupils, can provide valuable recommendations based on training and experience. The architect, using the ideas of the board, superintendent, and teachers, provides the professional planning which results in a satisfactory and economical building.

This series of guides is the result of numerous inquiries regarding both educational and technical planning which have come to Iowa State College. Educational and architectural specialists have helped in the preparation of each publication of the series. It is hoped that these guides will provide a sound basis for local planning of specialized departments.

SUGGESTED REFERENCES:

American School Buildings, 27th year-book, American Association of School Administrators, National Education Association, Washington, D.C.

Planning Together for Better School Buildings, Michigan School Building Handbook, State Department of Public Instruction, Lansing, Mich.

Before you Build, Boicourt, Gerald W., State Department of Public Instruction, Des Moines, Iowa. 1953.

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Project Approved by School Planning Committee, Iowa Chapter, American Institute of Architects, and the Iowa State Department of Public Instruction.

SCHOOL BUILDING PLANNING SERIES

PART III

A GUIDE FOR PLANNING INDUSTRIAL ARTS DEPARTMENTS IN IOWA

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FOREWORD

This bulletin brings in condensed form current philosophy and information that are basic to planning Industrial Arts (shops) departments for Iowa schools. It is designed to help in interpreting needs and specifications for an effective program that provides varied experiences. No two communities will have exactly the same problems in planning.

The current high cost of building and equipping necessitates very careful planning for economical and yet satisfactory facilities. The increasing High School enrollment must also be kept in mind. The developing program presents somewhat different needs but not necessarily more spacious or costly ones. This points up the great importance of calling upon the industrial arts teacher and the State supervisors in the State Department of Public Instruction for constructive help in the planning of shops in the schools of Iowa.

With this assistance, the architect can solve the physical needs of the school within budget limitations.

CONTENTS

INTRODUCTION

HISTORICAL DEVELOPMENT

Since shop work came into the schools of the United States, more than fifty years ago, many changes have taken place, especially in shop planning.

Industrial arts shops were first called "manual training shops", and in many instances were planned for production rather than as centers for education. The objectives of manual training were expanded to include such items as appreciations, attitudes, character traits, and technical information.

As a result of the Arts and Crafts movement, many new activities were added, and the shop program became manual arts. The type of shop organization remained much the same. Then shop work was brought into a closer relationship with industry and industrial life. From this came our present concept of industrial arts.

In most schools shop work was first housed in old buildings, old rooms, and basements. Until quite recently few new schools have housed shop work in space especially planned.

During the past decade, many fine facilities have been built. However, even today a large number of students enrolled in shop work are handicapped by shops that are inadequate.

LEVELS OF SHOP WORK

In most schools, several levels of work are offered in the school program beyond the elementary schools (Grades 1 - 6).

In the junior high school (Grades 7 - 9), industrial arts is offered to both boys and girls. The program provides experience in the use of tools, materials, processes, and products of manufacturing as well as those of the skilled trades and crafts.

In the senior high school (Grades 9 - 12), industrial arts is usually offered to those who show interest and ability in the industrial and technical fields.

Shop programs for adults vary with the interests and needs of the local community. They generally are concerned with consumer, hobby, and avocational, as well as vocational interests.

BASIC AREAS OF ORGANIZATION

The several types of basic shop organization depend on grade level, degree of emphasis, physical facilities, program, and locality. At the secondary and adult levels, three types of shop organization are usually recognized: (1) The general shop, (2) the general shop in a major area, and (3) the unit shop.

The General Shop. The general shop is a type of industrial arts organization for which the subject matter is selected from a variety of industrial activities. Different activities are generally carried on in one room under one teacher. The most common activities are woodworking, metalworking, electricity, and drawing. In the same shops a broader program may be offered which will include additional activities such as arts and crafts, graphic arts, and power mechanics.

In larger schools, this type of shop is frequently found at the junior high level as an introductory shop for all students before they elect other shop work. The general shop usually offers the best means for an adequate program for the small high school (Figures 1, 4, 6, 7, and 8 illustrate the general shop.)

The General Shop in a Major Area. In this type of shop, the subject matter is confined to one field of industry such as woodworking, metalwork-

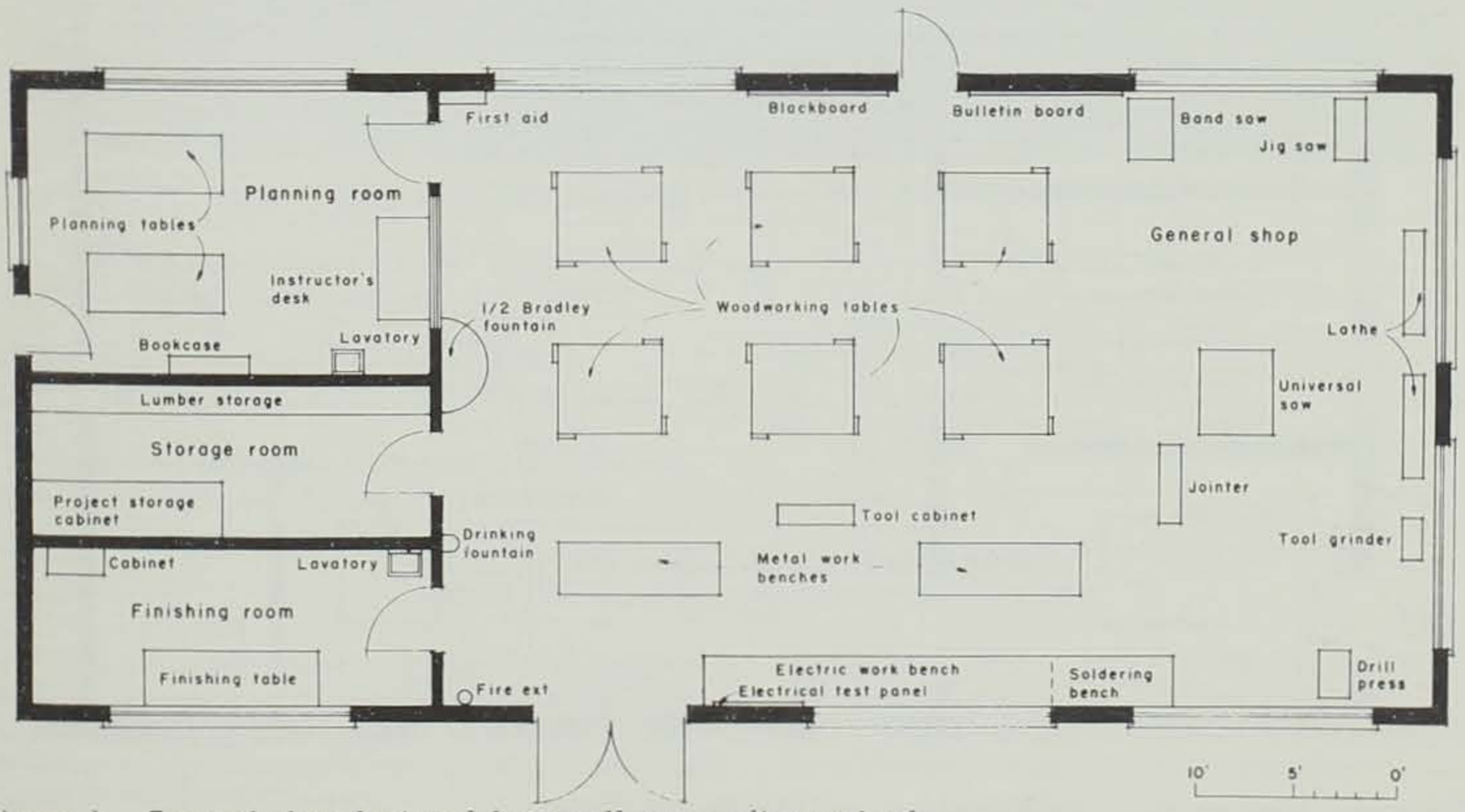

Figure 1. General shop designed for small and medium schools.

ing, and electricity. These are known as general wood, general metal, or general electricity shops. (Illustrations of this type of shop are shown in figures 4, 6, and 7.)

The Unit Shop. The unit shop is generally defined as a shop where one single activity is taught. The unit shop is generally found in the senior high school where several shops are provided. It is also desirable where the same shop is to be used for both industrial arts classes and Vocational-Industrial classes[7]. (Figures 5 and 9 show examples of this type of shop organization.)

SOME BASIC STEPS IN SCHOOL SHOP PLANNING

A review of local, state, and national trends influencing school shop planning may be made in the following manner:

Review current literature.

Review objectives and philosophy as they may influence planning.

Contact State offices and institutions of education relative to standards and available information.

Study shops which have been completed and are in use.

Consult with individuals who have gone through a building or remodeling program.

COMMUNITY SURVEY

Enrollment and projected enrollment trends, number of classes, and class size.

Objectives desired and program to be offered.

Extent of adult evening programs.

PLAN FOR FLEXIBILITY AND EXPANSION

Locate the shops so they can be expanded.

Plan the building arrangements so that night school can be held without opening and heating the entire building.

Plan transformers and electrical circuits to take care of expansion.

Have equipment movable to meet changing needs.

Equipment should be adaptable to different age groups.

Plan toilets, lockers, and washing facilities to take care of increased numbers in the future.

Plan non-load bearing partitions. Consideration may be given to movable partitions, glass partitions which aid in supervision or possibly no partitions at all.

PLAN FOR SAFETY

Use fireproof or fire-resistant materials.

Recess radiators, drinking fountains, and lockers in the wall.

Provide adequate lighting.

So plan that noise and fumes do not interfere with other school activities.

Avoid slippery floors and steep stairs.

Provide for adequate spacing of equipment and the establishment of definite aisles of travel and plan for proper work flow.

Install explosion proof switches where needed.

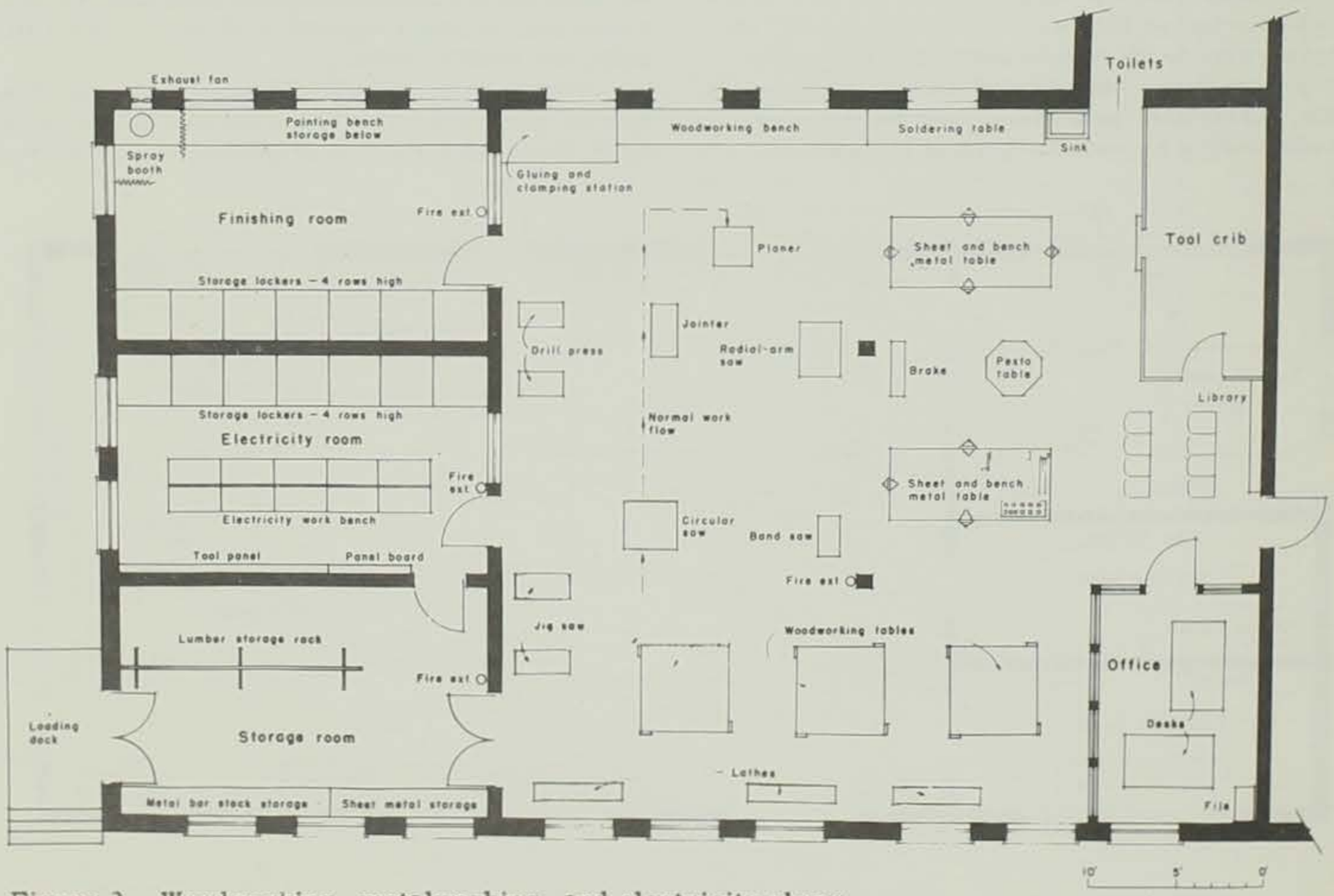

Figure 2. Woodworking, metalworking, and electricity shops.

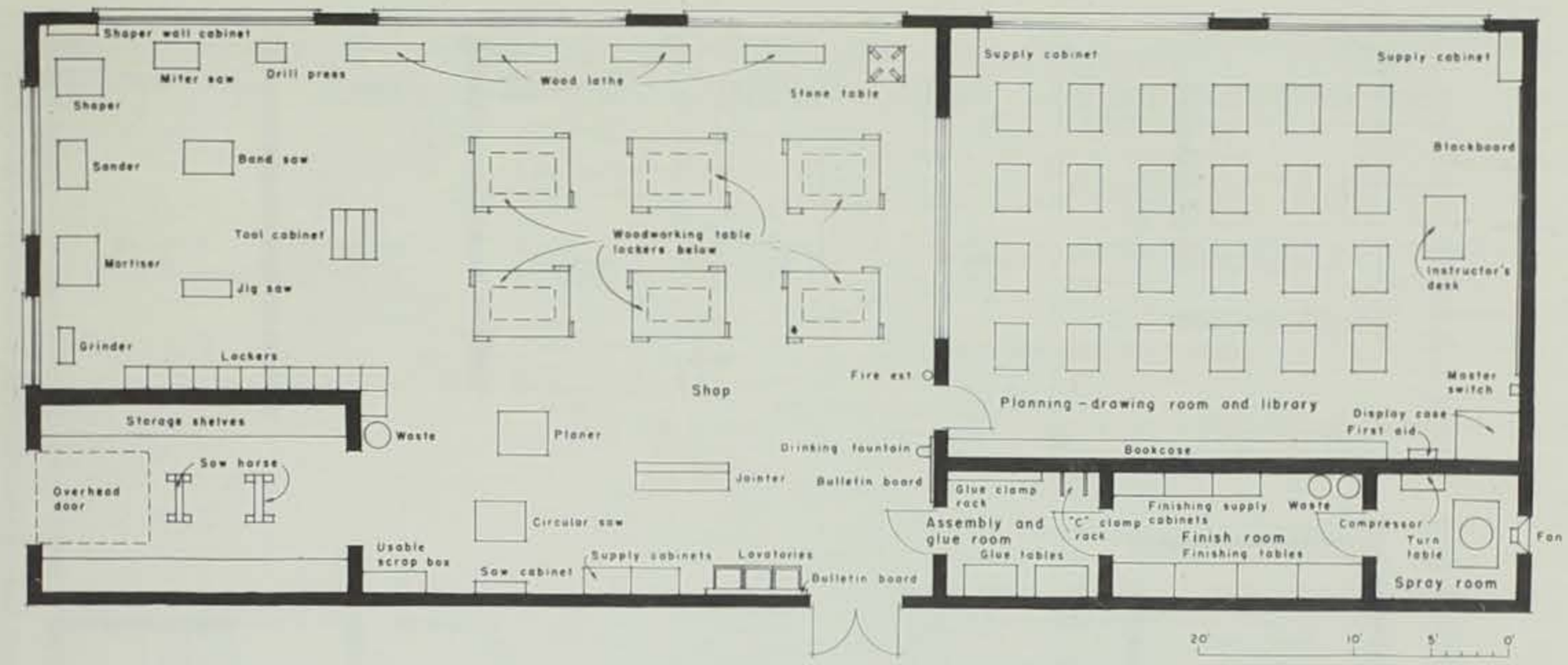

Figure 3. A combined wood shop and drawing room designed for small to medium schools.

Figure 4. General shop showing equipment and machine placement.

Plan for an adequate number of work stations.
Provide for storage of volatile fluids.

PLAN FOR ECONOMY OF OPERATION AND CONVENIENCE OF INSTRUCTION

Use materials that have long life, low replacement cost, and are easy to maintain.

Avoid having waste areas.
Plan the shop for easy supervision.
Plan facilities for lectures, demonstrations, and use of visual aids.
Provide adequate tool storage (see figures 14, 15, 16, and 17).

SUGGESTED MINIMUM STANDARDS FOR LAYING OUT AND PLANNING SCHOOL SHOPS

The following items are intended to be used by shop planners as a general guide in checking existing shops or planning for new shops[1]. It is difficult to give exact standards, since conditions differ from place to place.

LOCATION, SIZE, AND SHAPE OF SHOPS

The shop should be located in a wing of the main building or in a separate building.

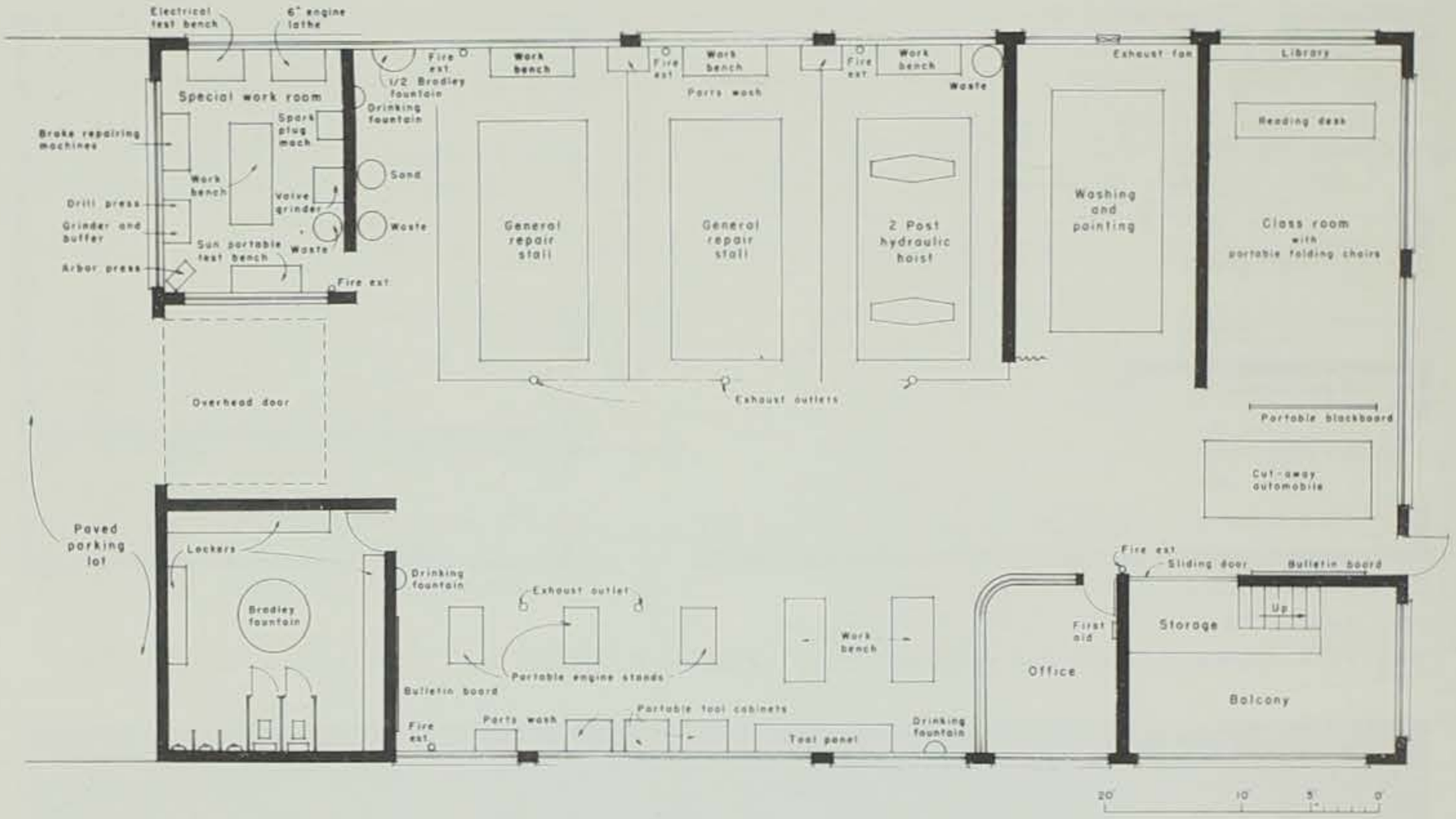

Figure 5. Auto mechanics shop.

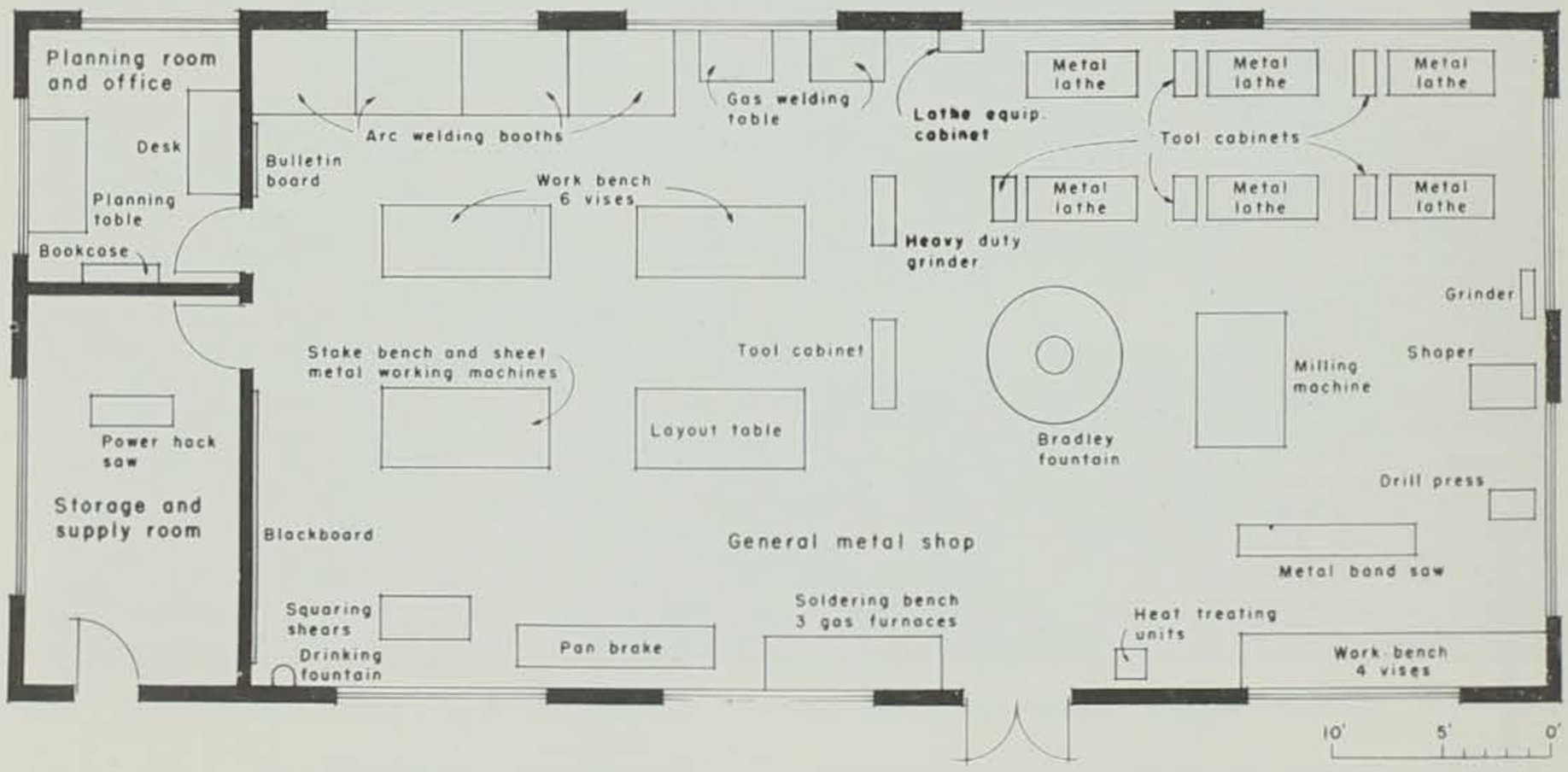

Figure 6. General metal shop designed for medium or large schools.

Shop units may be connected or attached to the main building by a hall, gallery, covered patio, or some similar arrangement.

Shops should be located on the ground level unless there are to be several shops; then light shops such as those for crafts, electricity, and drawing may be located on a second floor.

Shops should be away from the quiet area of the school to cause as little interference as possible. Shops should be away from playgrounds.

All shops that create fumes should be placed so that prevailing winds will carry fumes away from other school buildings.

Size. The area devoted to the shops should be large enough to permit future expansion. The size of the shop should be determined by the following factors:

Number of pupils to be accommodated. (Many schools set a limit of 24 students for industrial arts general shop and unit shop classes; vocational classes would in general be less in number. When it is necessary to go beyond the 24 student limit, adequate additional space must be provided.)

Shape. The most efficient shops are rectangular in shape, with a width-length ratio of 1 to $1\frac{1}{2}$ or 1 to 2. Irregular and unusual shaped shops should be avoided.

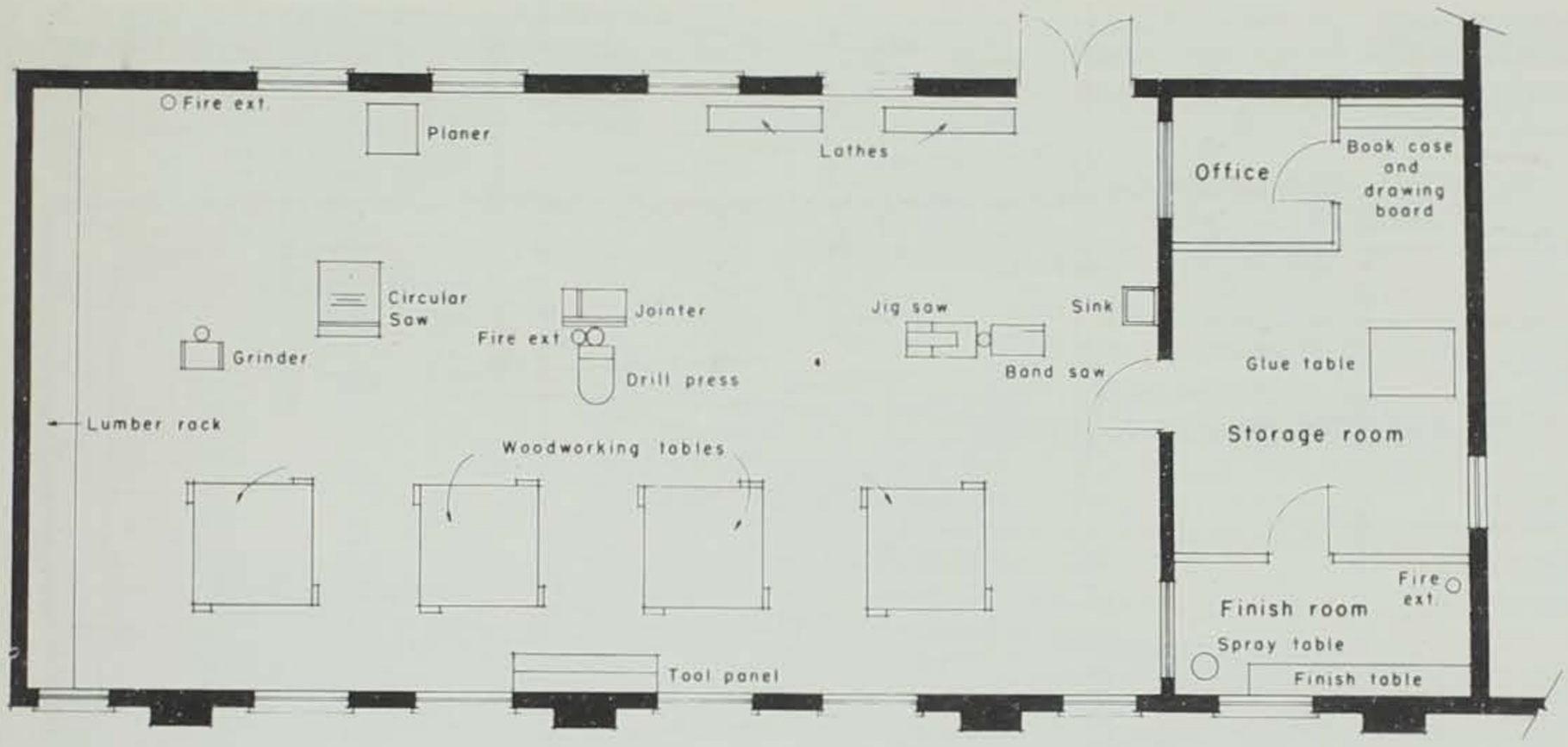

Figure 7. General wood shop for a small school.

SPECIFIC STEPS IN PLANNING SCHOOL SHOPS

If the suggestions listed previously have been followed, the instructor, the supervisor, the administrator, the advisory committee (if one is used), and others concerned with the programare now ready to develop specific plans.

Discuss with the administration and the architect the general program, shop load, standards, space needs, cost limitations, and building design.

Develop a scaled floor plan showing shape, size, major divisions, and auxiliary areas. Many planners find it helpful to draw the shape of the shop on squared paper, following the scale of 1/4 or 1/8 inch to the foot. A scaled template of each machine or piece of equipment should be cut out and lettered with its proper name. The templates can then be placed on the floor plan and moved about until a satisfactory arrangement is secured.

Assist the architect in the revision of preliminary plans. Sketches of built-in equipment can be developed at this time. Work with the architect and others concerned in checking and approving final plans.

REMODELING AND REORGANIZING EXISTING SHOPS

In many schools, the shop teacher and administrator will not have the opportunity to plan for new facilities. Their task will be one of modernizing the existing shop. Listed below are some of the more common things that can be done to modernize a shop.

Change windows and doors.

Add storage facilities. This may also mean tearing out present facilities and rebuilding.

Remove or change partitions.

Install new lights and power circuits.

Paint in keeping with modern trend.

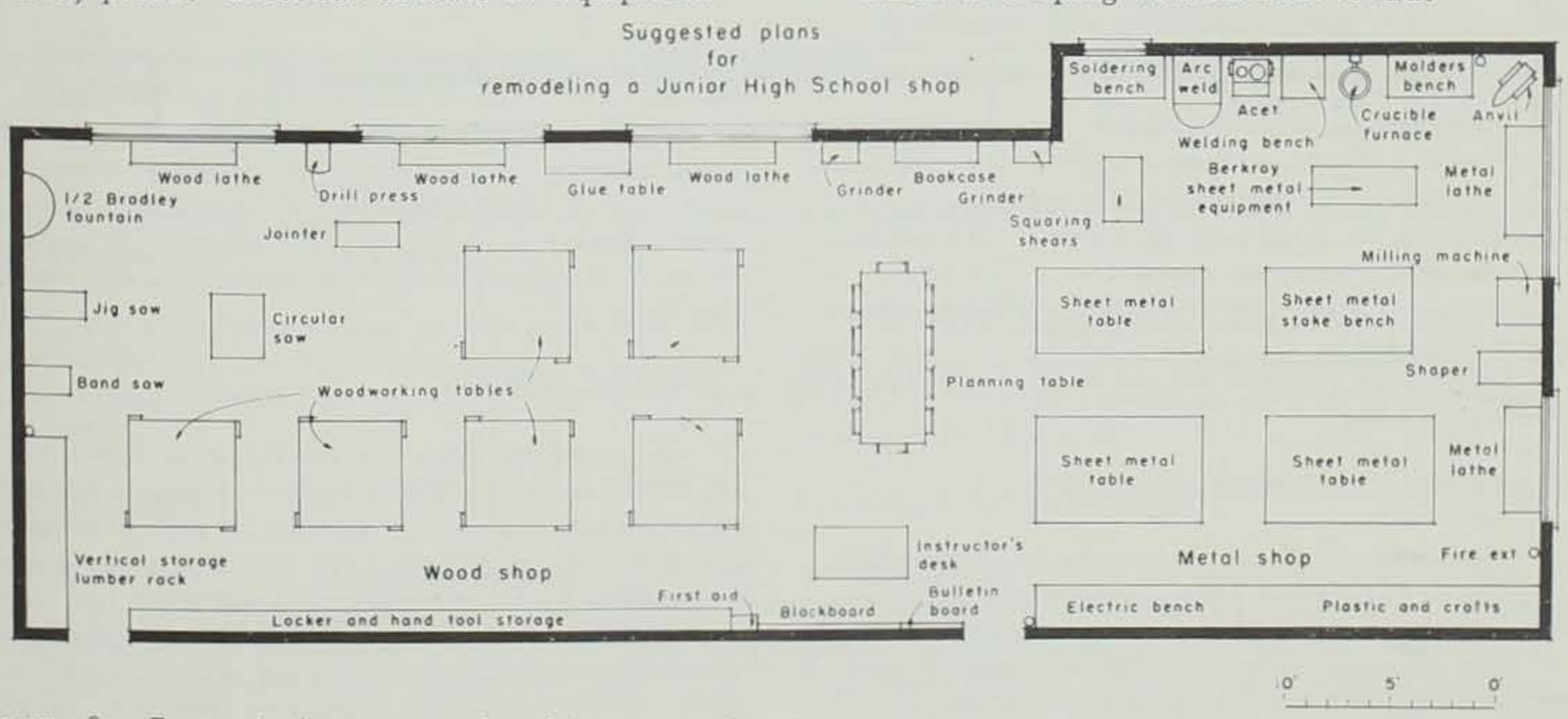

Figure 8. General shop — woodworking, metalworking, and electricity. A floor plan illustrating the results of remodeling and modernizing.

Add new services and utilities.
Replace old, olsolete equipment.
Cover or refinish old floors.

Often a complete remodeling plan cannot be carried out immediately but will have to be developed over a period of several years. (Figures 8 and 11 illustrate old shops which have been remodeled.)

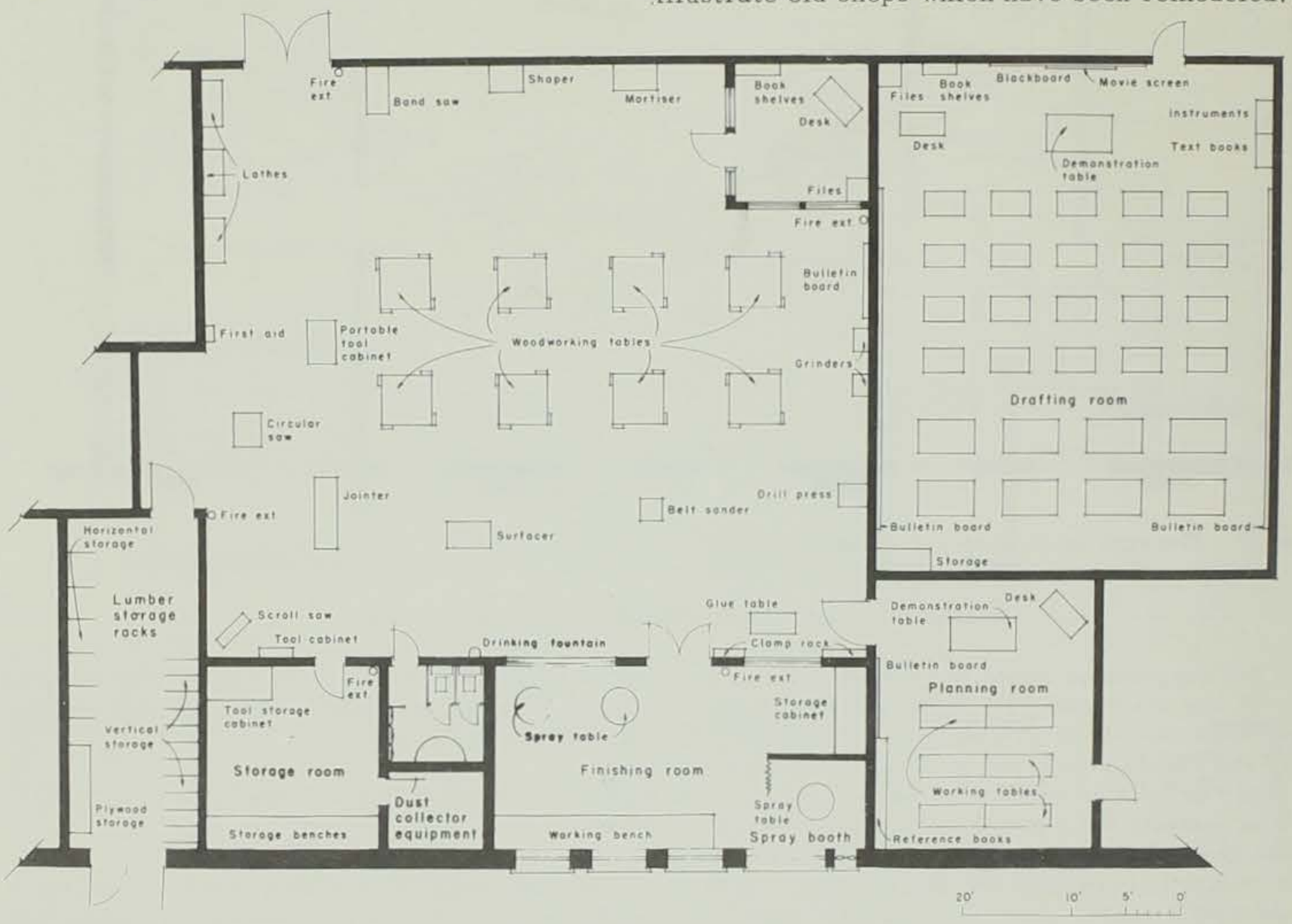

Figure 9. Advanced woodworking shop and drafting room.

AUXILIARY ROOMS AND FACILITIES

OFFICE

The instructor should have an office in the shop. It should be so constructed that the entire shop is visible at all times. The office should be large enough for a desk, filing cabinets, small table, chairs, and a magazine and book rack.

STUDENTS' LOCKERS

Lockers for the storage of students' personal belongings and for partially completed small projects should be in all school shops. The locker area should be easy to supervise. The area should have a space for changing clothing where this is necessary.

Additional lockers should be provided for adult evening classes.

PLANNING ROOM AND LIBRARY

The emphasis on planning as an important function of industrial arts focuses attention on the need for a place to carry on this activity.

The planning room and library should be well lighted and comfortable, with a minimum of 30 ft.-c. The furnishings should include chalkboards, shelves, cabinets for material, tables and chairs, wall charts, and provisions for visual aids. (Figures 12 and 13 are illustrations of types of planning centers.)

DEMONSTRATION AREA

Every shop should have a place where a class can be seated for demonstration or recitation. A combined recitation, demonstration, and planning room may be located for use by two or more shop classes. It should adjoin and be connected by a door opening directly into the shops. (Figure 13 shows a demonstration and planning area within the shop.)

FINISHING ROOMS

A dust free area for finishing is desirable in all woodshops. A glass enclosed space makes supervision easier. It should be kept at a temperature of at least 75 degrees F. The area should be equipped with a metal covered table for staining, a fire-proof cabinet for storing paints, stains, varnishes and brushes, drying shelves, and a sink. Direct sunlight should be avoided. A desirable size for small woodshops is approximately 12

Figure 10. General shop showing benches, stools for drawing, office, bulletin board, and chalkboard.

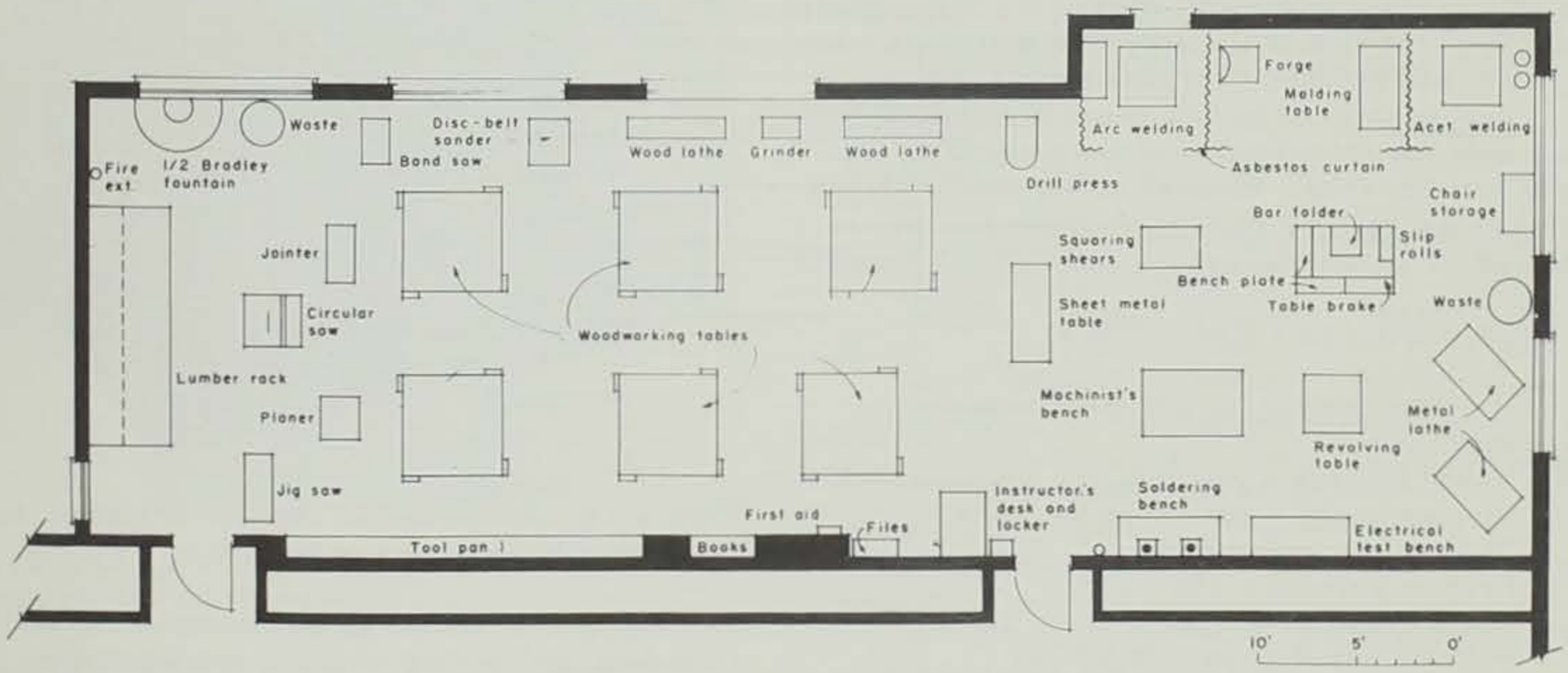

Figure 11. General shop - woodworking, metalworking, and electricity. The floor plan illustrates a remodeling and modernizing project.

by 20 feet. Finishing rooms should have individual exhaust systems, powered with spark-proof motors. Explosion proof fixtures, switches, and outlets are also needed.

LUMBER ROOM

The lumber room should be located for direct delivery or near receiving points. Sometimes lumber racks must be placed in the shop. The most satisfactory racks are made of pipes or angle iron.

Standard dimensions for lumber rooms are difficult to set down because the needs vary considerably. However, about 12 feet by 20 feet should be adequate for lumber.

STORAGE OF SUPPLIES

Provision should be made for the storage of such supplies as sheet metal, steel rods, bands and angles, finishing materials, and hardware. To economize in space and simplify administrative

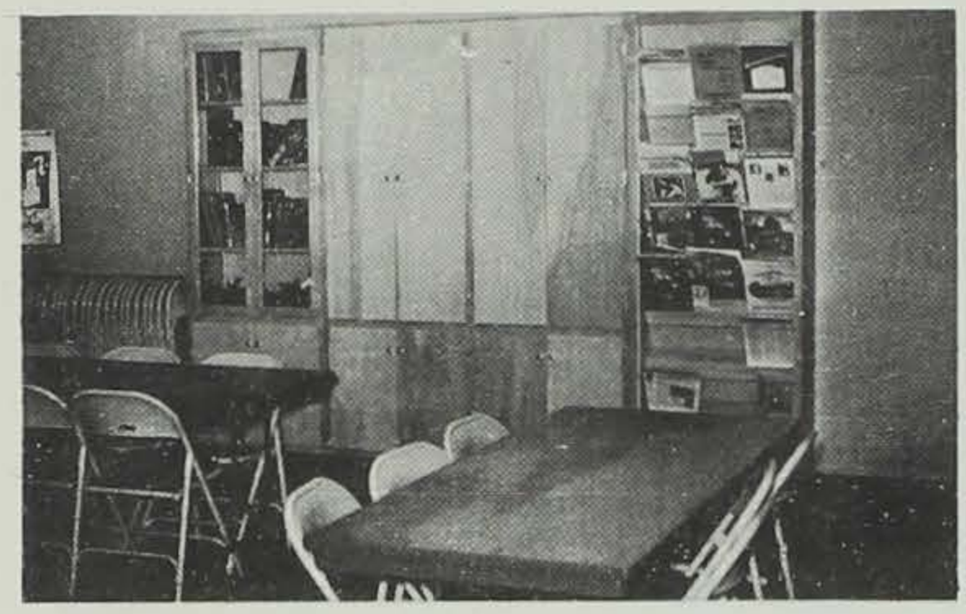

Figure 12. Combination planning room and classroom.

Figure 13. Planning and demonstration center located in one corner of a general shop.

control, these may be concentrated in a single room located between or close to the different shops. Racks and shelving should be such that the handling of long materials is easy; but no racks, shelves, or storage bins should be provided unless some specific article or material is assigned to them.

TOOL STORAGE

Tool room. The tool room, practical for large unit shops, should be centered as near as possible to all activities. The instructor should be able to observe it at all times. Its size will depend upon the size of the shop, the activities carried on, and number of students and classes.

Tool panels. The tool panel has become popular with the introduction of the general or multiple activity shop. Several small panels should be near the various activities. (Figures 14, 15, 16, and 17 illustrate various types of tool panels.)

OTHER AUXILIARY FACILITIES

Minimum standards for other auxiliary facilities:

Waste storage – provided for each activity.
Display space – near shop entrance.
Gluing area – 40 sq. ft.
Project storage – 300 cu. ft.
Chalk board area – 30 - 35 sq. ft.
Bulletin board area – 25 sq. ft.

POWER MACHINES

Machines should be placed so maximum sized material can be handled without danger of interference with adjacent workers or machines.

Machines commonly used should be in sequential order, in the order of their operational use. Machines used primarily in roughing out stock should be placed near stockroom.

Shops should have self-contained portable machines whenever practicable.

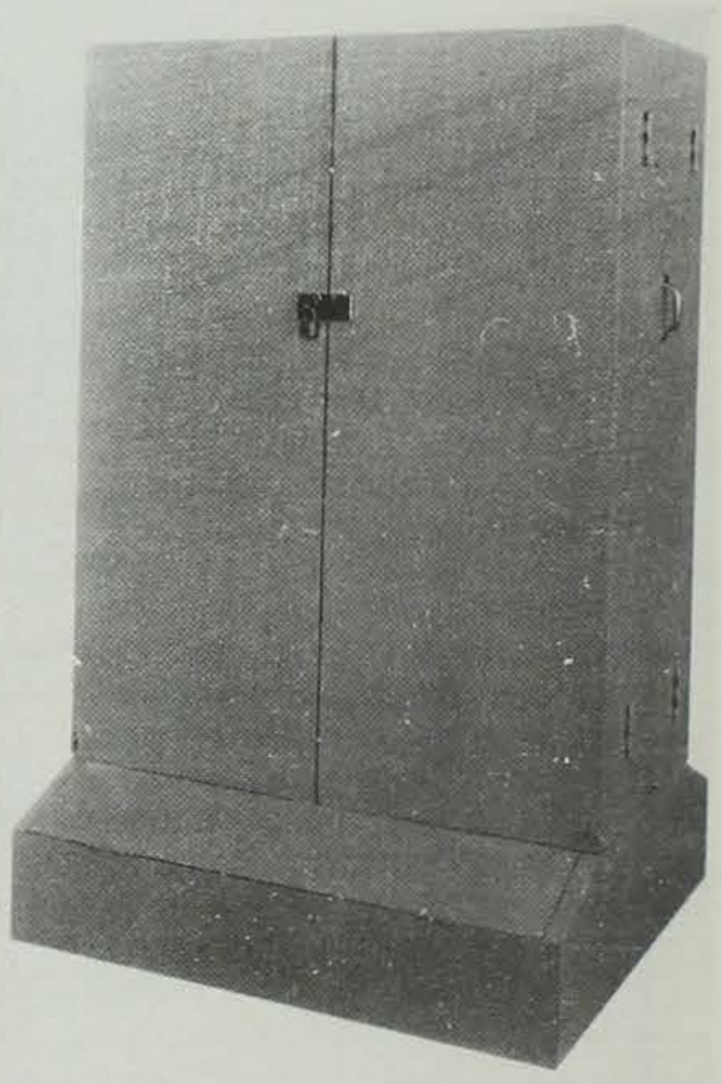

Figure 14. Portable tool cabinet designed for tools on both sides and in bottom.

Equipment should be so placed as not to interfere with the opening of doors and windows.

Arrangement of equipment should be determined by considerations of both safety and instructional efficiency.

Spacing between benches, machinery, equipment, and aisles should be sufficient for safety and free passage, a minimum of 4 feet.

Machines that vibrate should be cushioned with rubber mountings or other shock-absorbing material, and they should not be mounted on columns or against pipes that will transmit noise to other parts of the building.

Operation level of equipment when possible should be at the average elbow level of students.

DESIRABLE STANDARDS

HEATING AND VENTILATION

Heating systems recommended in shops are wall unit ventilators with fan, or split system (forced warm air and convectors, or radiant). If radiators are used, they should be recessed in the wall.

The temperature of the shop 60 inches from the floor should be 68 degrees.

The ventilating system used in the shop should be mechanical, and a separate part of main plant. It should supply a minimum of 15 cu. ft. of air per minute per student.

The relative humidity of shop and storage facilities should be 40 in the winter and 50 in summer. A dehumidifier is practical.

An exhaust system should be installed, and each area served by separate system through ducts placed overhead. Flexible tubing may also be run from master system to each area.

Separate exhaust systems should be provided to remove fumes from internal combustion engines, gas or electric welding, soldering furnaces, and painting booths. Separate systems must be provided for wood or grinding dust.

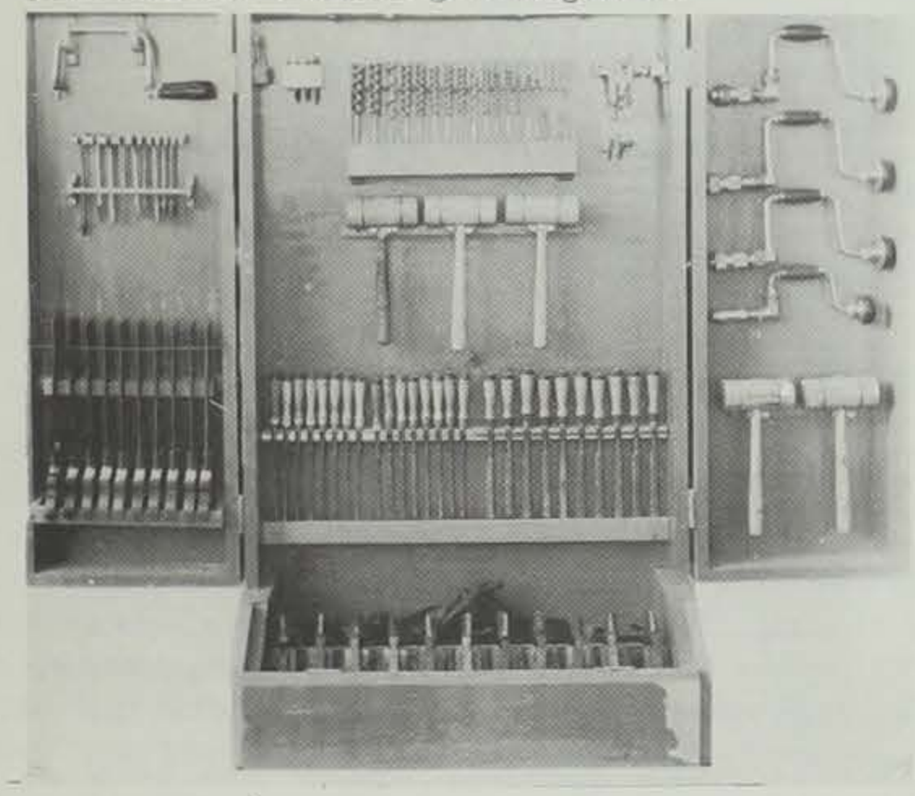

Figure 15. Portable tool cabinet, one side open showing placement of tools.

PLUMBING

Drinking fountains, one for every 20 to 30 pupils, should be in the shop.

Adequate washing and toilet facilities should be provided in or close to each shop.

Sinks are recommended for many shop activities. Hot water should be available in all shops.

Air compressor units should be outside the shop. Compressed air outlets should be located on the wall in the shop at 20 ft. intervals.

Gas outlets should be located at 20 ft. intervals in shops which use gas.

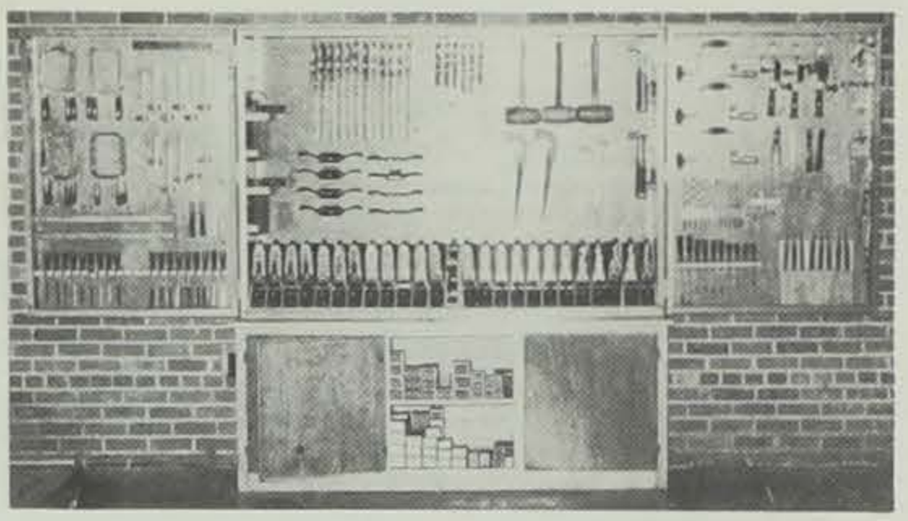

Figure 16. Wall tool storage cabinet can be closed and locked.

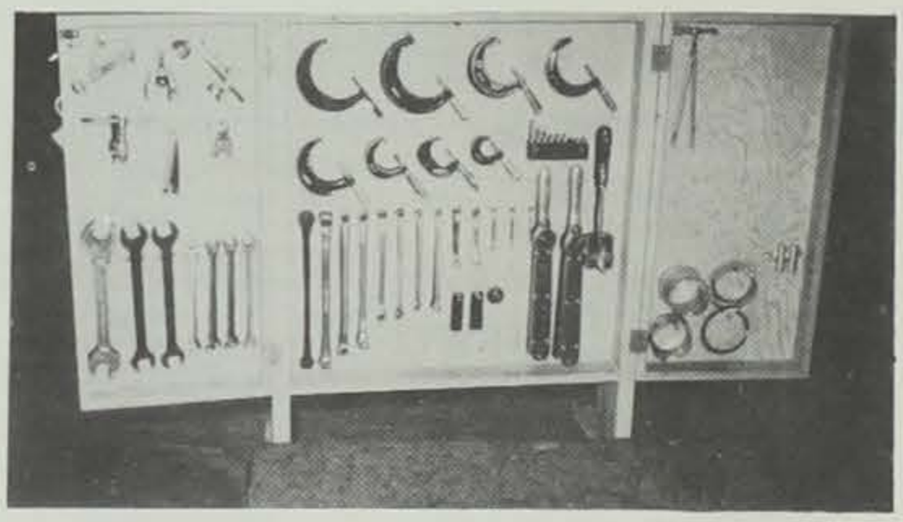

Figure 17. Portable specialized tool panel.

Safety and efficiency in teaching should be kept in mind.

LIGHTING AND ELECTRICAL

It is important that shop wiring be adequate for the maximum needs.

Master switches for power lines should be located so they can be locked when necessary.

Buss systems or raceways should be installed overhead for the larger unit shops.

Convenience outlets should be located above bench height at intervals of approximately 10 feet all around the room.

The shop should have an electric clock and dismissal bell.

Equipment should be so placed as to make maximum use of all lighting.

Each shop should be adequately lighted. The light should be well diffused, free of glare, and should cast no shadows. The following are minimum standards for shop lighting:

Over-all shop lighting	30 ft-c
Close work (machines)	40-60 ft-c

(Some machines and equipment may need to be individually lighted.)

Drawing room	30-50 ft-c
Reference, lecture, and demonstration room	30 ft-c
Wash room and store rooms	15-25 ft-c

ARCHITECTURAL REQUIREMENTS

GENERAL CONSIDERATIONS

These are not necessarily in order of importance:

Attractiveness and good design.
Cleaning and maintenance.
Ease or ability to be expanded.
Ease of equipment installation.
Flexibility and adaptability.
Moisture-proof, vermin-proof, and sound-proofing qualities.
Resistance to fire.
Structural strength.
Student and teacher comfort.

Below is a list of suggested number of square feet per student for various types of shops. These figures are approximate and do not include space needed for auxiliary rooms[5].

Type of Shop	Square Ft. per Student
General Shop	75 - 85
Hobby or Handicraft	50 - 60
General Woodworking	80 - 85
General Metal	75 - 80
General Electricity	70 - 85
General Drawing	50 - 60
Graphic Arts	70 - 75
Unit Shops	
Machine Shop	75 - 80
Drawing	50 - 60
Welding	60 - 70
Auto Mechanics	100 - 150
Radio - Television	60
Printing	85 - 100
Cabinet Making	80 - 100

FLOORS

The selection of flooring materials should depend on the particular activity for which the area is designed. Below are suggestions as to best types of flooring to use.

Woodworking area – hard wood.
Sheet metal area – hard wood or end grain wood.
Radio and electricity area – hard wood or composition.
Machine shop and welding area – concrete
General shop and welding area – hard wood and concrete.
Planning room – hard wood, composition, or rubber.
Drawing room – wood or composition.
Storage room and finish room – concrete.
Auto mechanics room – concrete.

WALLS AND PARTITIONS

Partitions between shops should be as nearly soundproof as possible, non-load bearing, and may be movable.

Partitions that form auxiliary rooms, such as planning rooms, finishing rooms, and offices, should have glass areas to permit supervision.

CEILINGS

Shop ceilings should be 12 to 14 feet in height, and drawing room ceilings should be 10 to 12 feet.

Materials with a high coefficient of sound absorption should be used. Ceiling should be finished.

WINDOWS

Since natural light is so variable, a school shop may depend exclusively on artificial illumination, as is often true in industry. It is, however, often advisable to have as much natural light as possible. Windows should be on at least two sides of the shop, preferably the north and east.

Natural lighting should be controlled by light colored, diffusing shades. Metal venetian blinds or screening or roof overhang are also recommended. Clerestory lighting is excellent. Windows should be translucent below eye-level.

Window area should equal at least 25% of the floor area. The window heads should be nearly ceiling height.

Window frames, preferably of metal, should be easily opened and closed and locked.

Window ledges should be bevelled so they cannot become catch-alls.

DOORS

Safety latches should be standard equipment on all exit doors. Two entrance - exits are desirable.

Outside doors should swing outward, with doors to auxiliary rooms opening into the shop.

A minimum width of 36 inches is recommended for personnel doors. One door in every shop should be large enough for moving in the largest machine to be used and for taking out the largest project that will be constructed.

If a large overhead door is installed for the delivery of supplies and machinery, it should be approximately 12 feet by 12 feet.

SOUNDPROOFING

Acoustical treatment is advisable when shops are located near other school areas. A careful study should be made of local conditions to determin needs.

Materials such as glass, wood, and plaster reflect approximately 95% of the sounds that strike them. Materials used for soundproofing should have a sound-absorbing value of at least 60%.

SAFETY AND OTHER CONSIDERATIONS

Proper fire extinguishers should be provided in each shop.

Non-slippery floors should be placed around power machines. Danger zones on machines should be painted 17, 18.

The use of a standardized safety color code for painting shops and equipment is recommended.

A first aid cabinet and supplies should be in each shop.

Power machines should be well grounded, with switches in convenient places, and should be well lighted.

Gas welding tank storage should be outside the shop and preferably close to a driveway.

Drip pans should be provided for machines to prevent oil collecting on shop floors.

The instructor should be able to look over the entire shop area from any point.

Distinct aisles of travel, at least 4 feet in width, should be provided.

Open space should be provided near all doors and in front of tool panels or cabinets.

Space should be set aside in each shop for the proper placement of waste and refuse containers.

INTERIOR PAINTING AND COLOR SCHEME

Research done by industry and by paint companies has established interior painting and color coding[17,18]. A similar system should be used in school shops. It tends to reduce eye strain; and it encourages pride in the shop, aids in clean-up, and makes the shop more attractive.

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