

Summer 8-1-1961

Modern Specifications for a Junior High School Industrial Arts Area

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MODERN SPECIFICATIONS
FOR A
JUNIOR HIGH SCHOOL INDUSTRIAL ARTS AREA

A Research Paper
Presented to
the Graduate Faculty
Central Washington College of Education

In Partial Fulfillment
of the Requirements for the Degree
Master of Education

by
John James Pocrnich

August 1961

THIS PAPER IS APPROVED AS MEETING
THE PLAN 2 REQUIREMENT FOR THE
COMPLETION OF A RESEARCH PAPER.

Ned Phillips
FOR THE GRADUATE FACULTY

TABLE OF CONTENTS

| CHAPTER | PAGE |
|--|------|
| I. INTRODUCTION AND STATEMENT OF PROBLEM | 1 |
| Introduction | 1 |
| The Problem. | 2 |
| Statement of the problem | 2 |
| Importance of the study. | 2 |
| Scope of the problem | 3 |
| Definition of Terms | 3 |
| Industrial arts | 3 |
| Unit shop | 3 |
| Work station | 3 |
| Planning area | 4 |
| Storage center. | 4 |
| Finishing room | 4 |
| The Method | 4 |
| Present Facilities | 5 |
| Objectives of Present Program | 7 |
| The Junior High Program | 8 |
| Shop I | 9 |
| Shop II | 9 |

| CHAPTER | PAGE |
|--|------|
| Woodworking I and II | 9 |
| Mechanical drawing | 10 |
| II. SHOP ARCHITECTURE | 11 |
| General Characteristics | 11 |
| Location | 11 |
| Size and shape | 11 |
| Ceiling and walls | 12 |
| Exits | 13 |
| Displays and decoration | 14 |
| Windows | 15 |
| Auxiliary Rooms and Facilities | 16 |
| Storage rooms | 16 |
| Tool panel | 18 |
| Finishing room | 18 |
| Planning room and demonstration area | 19 |
| Gluing and assembly area | 20 |
| Miscellaneous rooms | 20 |
| Heating, Ventilation and Dust Collection | 21 |
| Heating and ventilation | 21 |
| Dust collection | 22 |
| Lighting and Electrical | 22 |
| Lighting | 22 |

| CHAPTER | PAGE |
|--|------|
| Electrical | 23 |
| Soundproofing | 23 |
| Floors and Floor Covering | 24 |
| Types of Equipment and Their Placement | 25 |
| Mechanical drawing | 25 |
| Woodworking shop | 25 |
| General metal area | 27 |
| Safety and Other Considerations | 27 |
| III. SUMMARY | 29 |
| BIBLIOGRAPHY | 30 |
| APPENDICES | 33 |

CHAPTER I

INTRODUCTION AND STATEMENT OF PROBLEM

I. INTRODUCTION

For some time this writer and other shop instructors have felt the industrial arts facilities at Carmichael Junior High School, Richland, Washington, to be inadequate in the light of present and future standards and needs. The school administrators are confronted with the increasing necessity of developing educational programs to meet the needs of youth and adults. As a result of rapid growth in scientific and technological developments, industry has become more complex and diversified. The industrial arts area of our schools has not kept pace with these changes. The planners of our industrial arts facilities must be sensitive to these factors.

Schools are more and more recognized as service agencies for an entire community. This attitude presents some rather interesting implications for the planner. School shops should be planned so as to provide flexibility of space and equipment for a wide range of instructional activities.

Too often the architect hired by the board to plan school

facilities does not possess the specific knowledge of modern shop requirements necessary for proper shop planning. He usually is not abreast of teaching methodology and industrial arts' objectives as they relate to effective shop facilities.

The key to planning good facilities is flexibility, for although the school plant is designed for present known needs, a farsighted approach providing flexibility of space, equipment, and services (gas, electricity, etc.) will be less apt to restrict future change (11:3).

II. THE PROBLEM

Statement of the problem. The purpose of this study was to develop the latest specification trends for developing physical facilities for an industrial arts area. Taken into consideration were the educational requirements of the school and the desires of the community. These standards and specifications culminated in a working floor plan appropriate to a specific area, Carmichael Junior High School, Richland, Washington, or possibly to other junior high schools contemplating remodeling or constructing areas of this type.

Importance of the study. The lack of standards to aid the school administrator and school architect in planning educational industrial arts areas was felt. The writer attempted to gather useful sets of specifications for planners of junior high school shop areas.

One of the greatest values of this study is its report of expert consensus in each of the areas for which standards are listed.

Scope of the problem. The study, limited to industrial arts on the junior high school level, was further confined to the following areas of instruction: woodworking, general sheetmetal, electricity, and mechanical drawing. The financial aspect, although important, was not considered. In addition, the writer did not burden this study with an extensive listing of small equipment requirements for shops except where this machinery, permanent or stationary, had to be planned for in the floor layout.

III. DEFINITION OF TERMS

Industrial arts. Industrial arts, a phase of general education, involves preparation, growth, and guidance for modern living through experiences of working with materials, tools, and industrial processes.

Unit shop. This is a laboratory in which some single occupational area of shop work such as woodworking, metals, or electricity is taught.

Work station. This is a location at which a pupil may be engaged in the shop during the class period.

Planning area. In this place a pupil may plan his work, prepare drawings, and use the shop reference library.

Storage center. This is the area (usually separate from the main shop area) where tools, supplies, materials, and projects may be stored.

Finishing room. In this area completed projects are finished (painted, varnished, or stained).

IV. THE METHOD

The listing of specifications was derived from statements of principles, standards, criteria, and objectives found in literature on school shop planning and also from recommendations of industrial art instructors in the field. Visits were made to those junior high school shops in the area constructed within the past few years or presently under construction. From these sources of physical facilities mentioned by various authors as important for the planner, were compiled the specifications and standards. These educational specifications, in the form of written statements, were evolved and organized under eight phases of school shop planning: the general shop characteristics, auxiliary rooms and facilities; heating, ventilation, and dust collection; lighting and electrical; soundproofing; floors and

floor covering; types of equipment and their placement; and safety and other considerations.

The culmination of the study was the development of a floor plan (Appendix C) for the proposed industrial arts wing at the junior high school, utilizing all the modern specifications listed.

V. PRESENT FACILITIES

In order to present a concise picture of the industrial arts area at Carmichael Junior High School and show some of the inadequacies, it is necessary to give a short history of the present situation.

The present building, constructed in 1948, by most school building standards is not old. The difficulty arises in that the plans were drawn in Washington, D. C., under federal government specifications, with little or no understanding of local conditions. The program had to be developed around the constructed facilities, but the opposite is the ideal. The building has a rated capacity of 820 students. Presently, slightly over 900 are enrolled, with an anticipated increase in the future. The increased enrollment will in part be felt by the already crowded shop classes. At present the industrial arts area consists of three rooms on the ground floor of a two-story wing. (See Appendix A).

The woodshop area is 72 feet by 24 feet, giving a total area of 1,728 square feet, or 72 square feet per student, classified as inadequate floor space by the California School Shop Planning Committee (2:3). Space was not provided for student planning, a teaching center, or large project storage. Completed projects must be carried some distance down a hall to a closet intended for custodial supplies. The finishing room is not equipped with water facilities for cleaning equipment nor an exhaust fan system for removing fumes. Noise and vibration from the shop machines is such that teaching in the two classrooms directly above is most unbearable to the teacher and students when equipment is in operation.

The sheetmetal area has limited space for anticipated curriculum changes and improvement of instruction with the addition of new equipment. As in the woodworking area, space is unavailable for student planning, teacher demonstration area, storage of materials, and large project storage.

Off storage for these shops is located in an area beneath the bleachers of the gymnasium, on a different floor level and at some distance from the industrial arts area. This poses a supervision problem as well as difficulty in transportation of lumber and other materials.

The mechanical drawing room, a converted classroom 36 feet by 24 feet, is used to house 28 drawing desks. This is 15

square feet per pupil less than recommended by the California School Shop Planning Committee (2:3). Space is not available for reproduction equipment or proper storage of drawing tools and equipment.

VI. OBJECTIVES OF PRESENT PROGRAM

The industrial arts curriculum was formulated with emphasis on non-vocational training and industrial arts as an essential part of the general education of every boy in the Richland District (11:1). Keeping this in mind, the teachers and administration of the Richland School District formulated the following objectives for the industrial arts program:

A. Exploratory

Provides for occupational exploration for vocational guidance.

B. Practical Training

Develops work habits and attitudes. Furnishes a knowledge of tools and materials common to industry and develops skill in handling those tools.

C. Trade Background

Although not explicitly aimed in this direction, the shop program definitely prepares many students for vocations such as draftsmen, carpenters, engineers, cabinet makers, and many others.

D. Safety Training

Affords practice in safety related to home, school, and industry--both individual and group health and safety.

E. Transfer of Training

It is the conviction of the shop programs that instruction received will stand the individual in good stead regardless of the profession he may later choose. It is conceivable that knowledge of tools and tool operation would be of great value to the future doctor, lawyer, or in any other vocation one might name.

F. Problem Solving

To teach practical and analytical patterns for problem solving and self-dependence along these lines.

G. Avocational Possibilities

With increased leisure time available to all citizens, wise use of this time is an important consideration.

H. Consumer Education

Appreciation of craftsmanship and good design (14:2).

VII. THE JUNIOR HIGH PROGRAM

The present industrial arts program is taught on the unit shop theory. Classes are of 55 minute duration, five days a week,

with pupils registered in a given type class for the entire school year. In the three grades, all classes are selected on an elective basis. Description of the courses included and their year of selection follow.

Shop I. General Metal and Electricity (Grades seven or eight). Among the important experiences covered are sheet metal, layouts, design of projects to scale, selection and background of different types of metals, forming and assembling of projects by hand and with the different machines, wrought iron bending, soldering techniques, and care of shop equipment. In the electrical phase the boy receives experiences in principles of electricity, electrical symbols and diagraming, construction of small motors and transformers, repair of simple appliances, and an introduction to electronics.

Shop II. Beginning Woodworking (Grade eight). The beginning woodworking class will cover the following broad areas of instruction: hand and power tool uses and operation, jointery and paneling, preparation of woods for finish, finishing with various types of finishes, woods and lumbering, design drawing of minor projects, and construction of simple projects.

Woodworking I and II. Advanced Woodworking (For ninth graders). This class is a deeper penetration of the subjects covered in Shop II, with addition of furniture construction, operating

procedures on all power equipment, spray finishing and its application, and knowledge of cost estimate procedures.

Mechanical Drawing. (Grade nine). Units of instruction are freehand sketching, orthographic and isometric projection, geometric problem solving, revolutions, floor plans for house development, use of ink in tracing, blueprint reading, and the process of reproducing drawings.

CHAPTER II

SHOP ARCHITECTURE

I. GENERAL CHARACTERISTICS

Location. The following specifications are concerned with the general location of the shop in relation to the rest of the school building.

1. The industrial arts area will be housed apart, but not isolated from, the general school plant.
2. The wing addition is to be connected by a covered walk passage for protection of students during inclement weather.
3. The location is such that it will be easily accessible for community use in adult evening classes.
4. The building will be one story in height.
5. The area is to be on ground level for drive-in receiving of materials and equipment.
6. The wing will be of the same general design as the present structure for continuity of beauty.

Size and shape. The size was designed for a class load

of 24 pupils in each shop and 30 in the mechanical drawing classes.

1. The woodshop and general metal room are 80 feet long and 38 feet wide, within the required ratio of not less than 1:1 1/2 but not more than 1:2 as to width and length.
2. Space allotment for open shop area in the woodworking and general sheetmetal is 125 square feet per student.
3. The mechanical drawing space, 60 feet by 24 feet, gives over 45 square feet per pupil.
4. All auxiliary area space was not included in the square foot per student consideration.
5. For ease of supervision there is no irregular area that cannot be observed by the instructor from any position in the shop.

Ceiling and walls. Materials used to fit local requirements are left to the discretion of the architect.

1. The minimum for all shop ceilings is 14 feet. This height was used in the study to allow for a storage balcony on one side of the shop.
2. Partitions between shop and auxiliary rooms are of the nonbearing type and as free as possible from mechanical and utility installations. (This is to allow

for conversion of two shops into one or so that space arrangements can be made as conditions in later years warrant).

3. There are no supporting columns in the area to break shop room into hard-to-use spaces.
4. Height of the wainscoting will be four feet above the floor, constructed of hard plaster, painted, or glazed material.
5. Provisions are made for transparent partitions between the shop and all auxiliary rooms for ease of supervision.

Exits. Specifications for doors must meet the local and state code for safety fire protection.

1. All doors are to open outward and be recessed where opening of the door projects into a hall.
2. All shops are provided with fire exits that are plainly marked and easily accessible.
3. There is to be a large overhead door into the lumber storage area for ease of delivery.
4. One door is large enough to permit movement of the largest single piece of shop equipment.
5. All doors have a glass window to reduce the possibility of accidents.

Displays and decoration. Publicity and public relations is an important aspect of the shop teacher's job.

1. A lighted exhibit case will be provided either in the shop or in a central location in the principal part of the building for exhibiting completed class projects.
2. As much cork bulletin board as possible is provided in each shop for display of pertinent shop information.
3. The ceiling and walls are to be painted with a flat, high reflection factor paint.
4. Furniture and other shop equipment will be finished in light rather than dark colors.
5. Wilbur gives the following recommendations for color comfort:
 - a. Paint the walls a receding color, such as green.
 - b. Paint under surfaces white in order to reflect light into dark corners.
 - c. Paint machines and equipment a color which will harmonize with the walls. For example, if the walls are green, the machines may be a slightly darker shade of the same color.
 - d. Paint working surfaces light to contrast with the work.
 - e. Paint operating controls a bright color, such as

yellow.

- f. Reserve the use of red for danger. Thus, the electrical switches on all machines might be colored red.
- g. Use small amounts of bright colors in the right places to "set off" the rest of the shop and to lift it from the ordinary (19:256).

Windows. The quality of work done by pupils, their safety, and their physical welfare requires the prompt use of artificial light whenever weather conditions indicate it (13:22-23).

1. Natural light will be used to the fullest advantage whenever possible.
2. Windows are placed on the north side only to combat the sun and heat problem in the locale.
3. The lower level of the windows is to be as high above the tops of the workbenches as practicable.
4. Use of adjustable Venetian blinds is preferred since they make it possible to direct the sunlight at different angles without shutting out light from the sun and sky.
5. Steel sashes of the awning or deflector type are used for ease of maintenance.
6. Generally, a commonly accepted figure for natural lighting is 20 per cent of the floor area.

7. Too much glass will increase the inside temperature of a room due to the radiation factor of glass.

II. AUXILIARY ROOMS AND FACILITIES

Storage rooms. The planning of storage facilities for tools, materials, and projects must be an integral part of any physical layout and program organization (13:39).

1. The general supply room is to have an overhead outside door convenient to a delivery truck unloading platform.
2. The doors in the opposite end of the storeroom are to open directly into the shop.
3. The lumber racks are constructed to enable one to pull any width board to the desired length and cut without removal from the storage area.
4. There will be a sufficiently large number of divisions in the storage racks to permit a complete classification of lumber by kinds, grades and sizes.
5. A "short rack" used to store lumber under thirty-six inches in length is provided.
6. A plywood storage rack is located behind vertical lumber storage.
7. A power hand saw is located in the wood storage room

for convenience of cutting lumber before removal from the room.

8. For economy of space all around, flat and bar metal is stored in vertical bins that have a pitched base for safety.
9. An area for storage of stock supplies in a general storeroom is provided. Standard size units of cabinets, adjustable shelving, and bins are to be selected.
10. A wall type storage rack for bar clamps, C-clamps, and handscrews will be placed next to the glue or assembly area.
11. Supply cabinets for nails, screws, sandpaper, etc., will be below the tool panel.
12. All paints, stains, and other volatile materials are to be stored in steel cabinets.
13. Storage area for individual pupil's personal supplies is included in the shop area.
14. Open floor area within the storage room is provided for unfinished but assembled projects which may be too large for regular storage lockers.
15. Additional storage space is provided by a balcony over the auxiliary rooms.
16. Extra personal storage is provided in the base of each

work bench.

Tool panel. The open tool panel, one of the most powerful visual materials, is, therefore, one of the most useful and effective teaching aids in the shop (4:59-63).

1. The tool panel is to be located near the center of the shop.
2. An open area of at least six feet in front of the panel will prevent congestion.
3. The panel is constructed so that it may be closed and locked when class is not in session.
4. Arrangement of the tools on the board is in "tool families" for ease in location.
5. To facilitate checking of tools, a scheme of color identification for each tool is used.
6. Specialized tools are stored on decentralized panels near the individual machine.

Finishing room.

1. The room is constructed so it can be kept free from dust with a temperature above seventy-five degrees Fahrenheit.
2. Equipment will be a spray booth and a table or bench for staining and painting.

3. The spray booth is to be equipped with an exhaust fan for the removal of fumes.
4. All counter tops are covered with stainless steel or other easily cleaned metals.
5. For safety, arc-proof light fixtures and switches are installed in the finish room.
6. The room will be equipped with a porcelain sink having extra large drains for cleaning brushes and other equipment.

Planning room and demonstration area. These rooms are utilized by pupils in analyzing and planning their projects, in studying related technical facts needed in the execution of projects, and in making preliminary sketches of their own designs of projects (10:16).

1. For economy of space, for better supervision of pupils, and for easier cooperation of teachers and integration of their work, a student planning center was enclosed in glass and located between the two shops.
2. A demonstration bench is mounted on a six inch platform so that all students have equal opportunity to watch the teacher.
3. Chairs with arm boards are provided for paper work and testing.

4. The demonstration room has a chalk board, bulletin board, bookcase and magazine rack, and a place to store drawing boards.
5. To provide for the use of audio-visual materials such as filmstrips and motion pictures, the room was equipped with darkening curtains for all window areas.

Gluing and assembly area. This area is most often neglected by the shop planner.

1. Its area is large enough to provide space for assembly of the largest project planned in the shop.
2. It is located adjacent to the finish room for convenience of moving projects.
3. The glue table is constructed to provide for clamp holders and an electrical outlet.

Miscellaneous Rooms. Grouped here are rooms of lesser importance but still a necessary part of the industrial arts area.

1. The office, best located near the main entrance, provides space for a private desk, files for records, supplies and equipment catalogs, and private professional books.
2. The office overlooks the general shop area by means of a glass partition.

3. A wash room with one wash station for each ten pupils in class is provided.
4. The semi-circular industrial type wash station is used for economy of space.
5. A drinking fountain is provided to reduce the desire or need of the students to leave the shop.

III. HEATING, VENTILATION AND DUST COLLECTION

Heating and ventilation. The system should maintain comfortable and healthful conditions at all times.

1. The heating system will be a heat-pump unit installed on the roof of each shop. This type will provide heat during the winter months and refrigerated air conditioning during the warm months.
2. The heating system will automatically maintain an ideal temperature of sixty-eight degrees Fahrenheit for the shops.
3. A mechanical ventilation system will provide fresh air constantly and keep it gently in motion.
4. The exhaust system is located so that it will not direct the fumes toward the windows of an adjacent building.

Dust collection.

1. An under floor dust collection system is attached to each of the power tools. The dust and shavings are piped to an outside vacuum collector.
2. This system also includes a sweep-in duct for disposal of shavings around the bench area.
3. Clean out vents are provided wherever the ducts make a necessary sharp bend.

IV. LIGHTING AND ELECTRICAL

Lighting. It is essential that teachers give serious attention to the matter of providing adequate lighting for their industrial arts shops, especially since it has been demonstrated that the development of students is influenced by the quality and quantity of lighting provided (7:90-93).

1. The light fixtures are to be ten feet above the floor.
2. The fixtures are slim-line fluorescent tubes with frosted glass covers to insure thorough diffusion of light.
3. The candle power rating for shop activities will not be less than thirty-five and in the mechanical drawing and planning areas fifty candle power is recommended.

4. Light switches are located near the main entrance for convenience.

Electrical. This includes all items related to the power output in the area.

1. The main power panel is located near the instructor's office.
2. Master emergency throw-out push button switches are located at strategic points about the shop.
3. All power machines are individually fused.
4. Power for both 110-220 single phase and 220 three phase is provided.
5. Overhead wiring for bench and machine outlets is provided at all necessary stations.
6. Outlets along the wall are to be located approximately ten feet apart in order to accommodate the portable electrical appliances.

V. SOUNDPROOFING

The acoustical treatment for auditory comfort of students within the shop as well as for classroom which may be adjacent to or in the vicinity of the shops is important (17:90-97).

1. Effective noise absorption is accomplished by using acoustical tile on the shop ceiling and acoustical plaster

on unbroken walls above the wainscoting.

2. Much noise can be prevented at the source by keeping power saws and planer knives sharp and properly adjusted.
3. Transmission noises will be greatly reduced by lining hoods and ducts with sound-absorbing material and by placing canvas sleeves between fans and ventilating and exhaust ducts.
4. The use of rubber, cork, or fiber board under all machine bases secured to the floor will remove much of the vibration noise.

VI. FLOORS AND FLOOR COVERING

The selection of flooring material should depend on the particular activity for which the area is designed. Safety plays a big role in the type of floor used.

1. The woodshop and general metals floors are of maple flooring.
2. Flooring in the mechanical drawing room is of linoleum tile.
3. The finishing room floor is to be a non-absorbent material.
4. The wood flooring will be finished with a material that

will reduce the danger of slipping, present a pleasing appearance, and be easily cleaned.

VII. TYPES OF EQUIPMENT AND THEIR PLACEMENT

Mechanical Drawing.

1. Equipped with the present mechanical drawing desks.
2. The main aisles of traffic are 48 inches in width and minor aisles are at least 36 inches wide.
3. Space between desks will be at least 36 inches.
4. Area around the blueprint machine will provide 2 feet to either side and 3 feet in front for proper operation.
5. Work space for the line reproduction printers is the same as for the blueprint machine.

Woodworking Shop. Proper placement of equipment observes

(1) safety precautions and (2) sequential order of use on a production line basis with minimum travel between machines.

1. The purchase and installation of youth size power machinery is for convenience and safety of the smaller junior high school boys.
2. All power equipment is mounted to the floor by use of commercial made mounting blocks cemented to the floor.
3. The circular saw is to have 8 feet on both sides of the blades and 12 feet in front of and behind the saw.

4. The jointer requires 10 feet at both ends and 6 feet on the operator's side of the machine. It is placed near the circular saw, as its operation usually follows work on the saw.
5. The drill press is located against a wall with at least 3 feet on the sides and the front.
6. The wood planer is located nearest the lumber room and has at least 12 feet of free work area at either end and 2 feet on each side.
7. The jig saws have 3 feet on the sides and front area and 12 inches to the rear.
8. The band saw has 8 to 10 feet on the sides.
9. Wood lathe specifications call for an area of 3 feet in front, 1 to 2 feet at either end, and 1 foot at the rear. They are arranged at an angle of forty-five degrees to insure that any work flung from the lathe will not be in line with the operator.
10. The radial arm saw is placed against a wall adjacent to the lumber rack. At least 12 feet on either side is provided.
11. All machines are equipped with the start-stop fused type switch so that each can be controlled independently; the switch box is located within easy reach of the operator.

12. Workbenches are placed with 3 foot aisles on all sides.

General Metal Area. Equipment in this area is placed the same as in the woodshop area.

1. The sheet metal brake, squaring shears, slip rolls, and bar folder all require work areas of 2 feet to either side and 2 to 3 feet in front and back clearance.
2. The sheet metal stand has a circular area with a radius of 36 inches.
3. All benches are provided with 3 foot aisles on each side.
4. The welding booth has a 24 inch clearance on three sides and 3 feet in front.
5. Molder's bench is set against the wall and provided with a 48 inch work aisle in front.

VIII. SAFETY AND OTHER CONSIDERATIONS

Safety instruction is an important part of the industrial arts program. Every effort should be made to provide safety features in shop planning. Some general considerations of shop safety provided are:

1. Fire extinguishers located conveniently near danger points. They are marked and labeled with instructions for quick use.

2. A first aid kit properly equipped is easily accessible.
3. Non-slip material is placed on that part of the floor where students stand while operating machines.
4. Proper grounding of all electrical equipment is essential.
5. Approved safety metal storage is provided for all used rags.
6. All gears, belts, and other moving parts are guarded wherever possible.
7. All shops are provided with easily accessible fire exits.
8. Due to the noise in the shops, fire alarm sounding stations are so located that there is no doubt about all people in the shop hearing the alarm.

CHAPTER III

SUMMARY

The inadequate industrial arts facilities presently in use and the increased enrollment causing crowded conditions in the area gave this writer the incentive to study the enlargement and modernization of facilities. With educational objectives and community interests as a guide, specifications and standards were evolved and set into a usable plan.

The floor plans designed will give spaciousness and versatility to the area. Specifications are not so detailed and rigid as to hamper the architect in use of construction design and new materials.

These industrial arts facilities when completed will provide an interesting and exciting environment for both students and shop teachers.

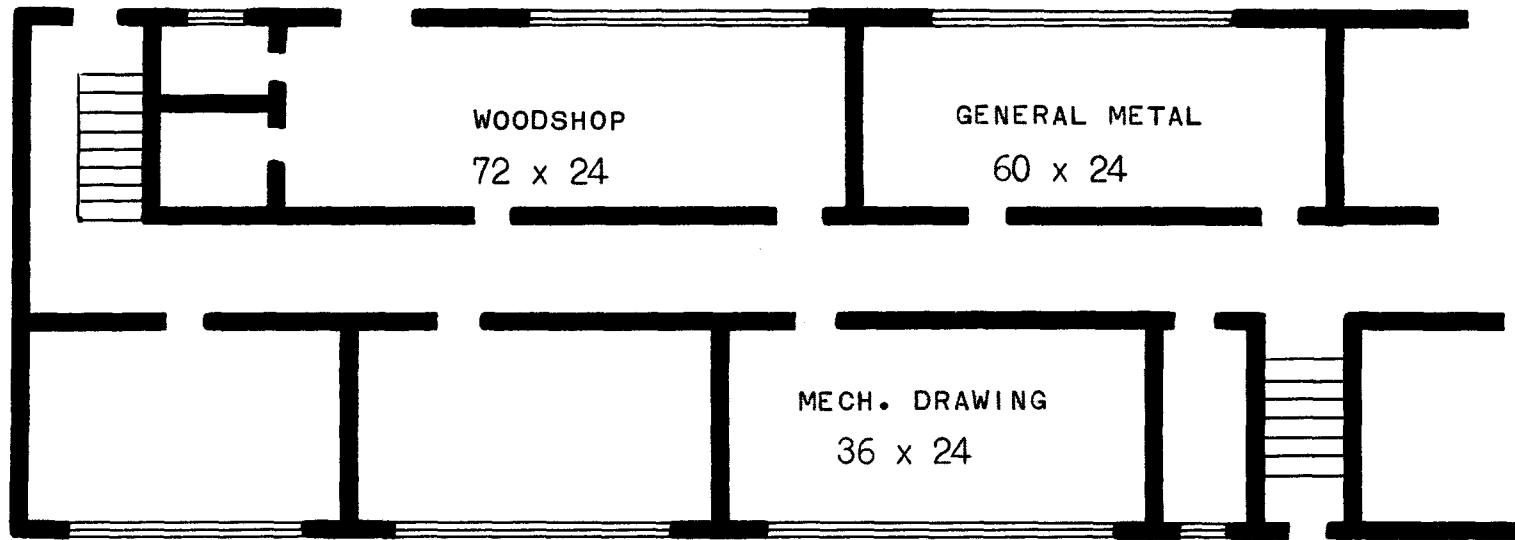
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APPENDICES



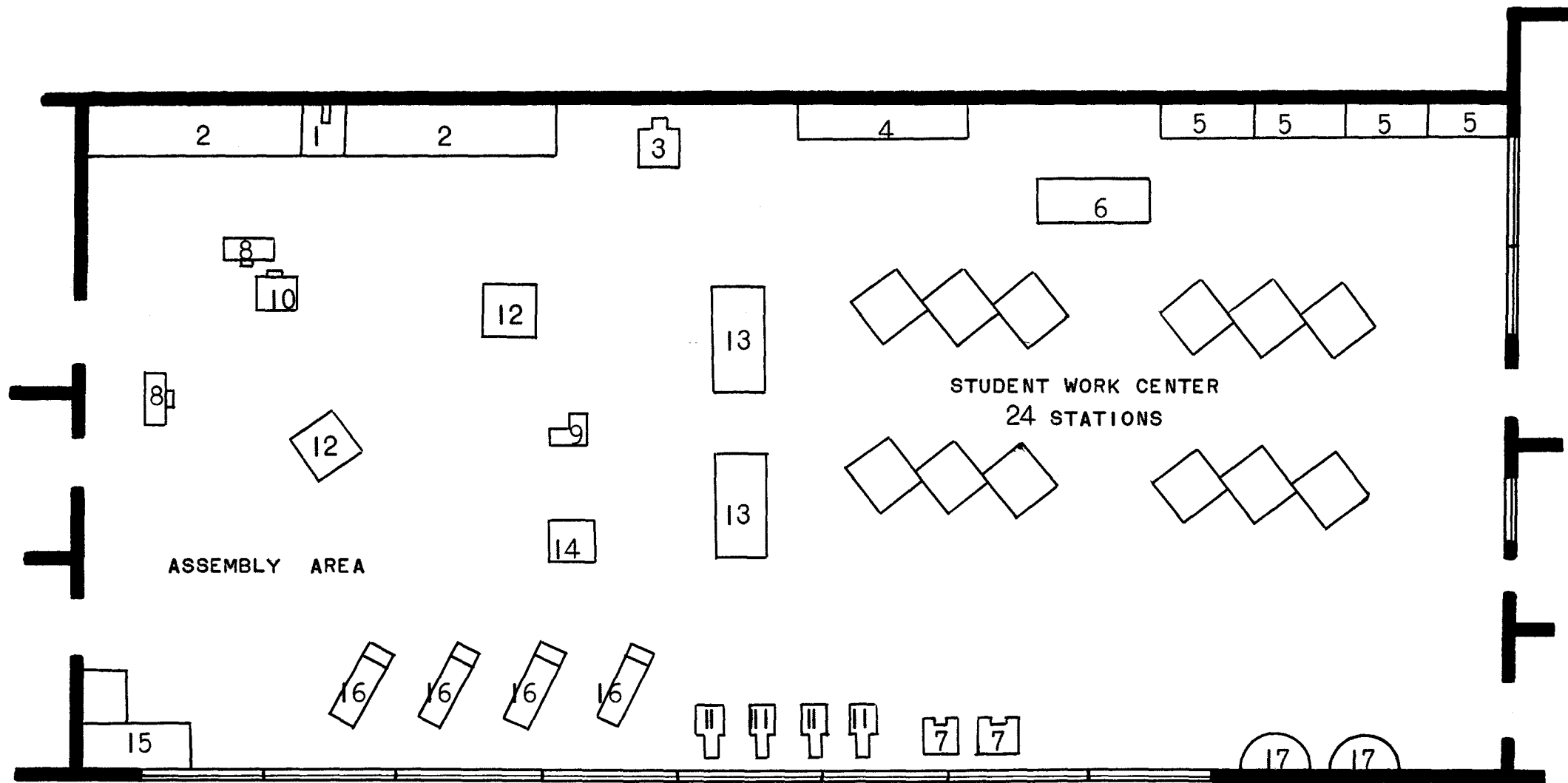
APPENDIX A

PRESENT INDUSTRIAL ARTS AREA
CARMICHAEL JUNIOR HIGH SCHOOL RICHLAND, WASHINGTON

APPENDIX B

EQUIPMENT PLACEMENT

WOODWORKING AREA



- KEY:
- 1. RADIAL ARM SAW
 - 2. UTILITY BENCH
 - 3. BAND SAW
 - 4. TOOL PANEL
 - 5. PROJECT STORAGE
 - 6. DEMONSTRATION BENCH

- 7. GRINDER
- 8. JOINTER
- 9. SANDER
- 10. SURFACER
- 11. JIG SAW
- 12. CIRCULAR SAW

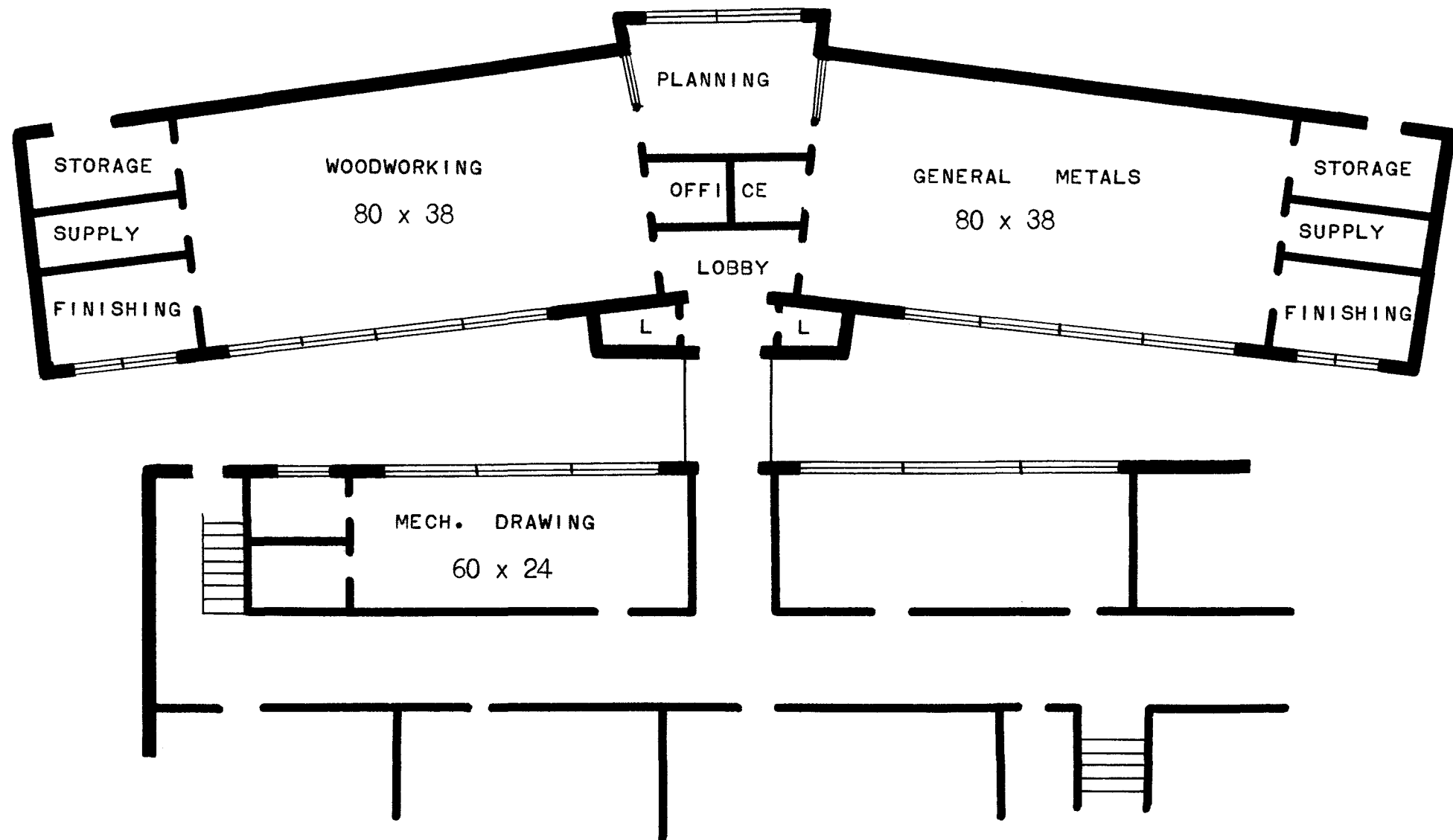
- 13. PROJECT BENCH
- 14. SHAPER
- 15. GLUE BENCH
- 16. LATHE
- 17. WASH STATION

APPENDIX C

REVISED FLOOR PLAN

INDUSTRIAL ARTS AREA

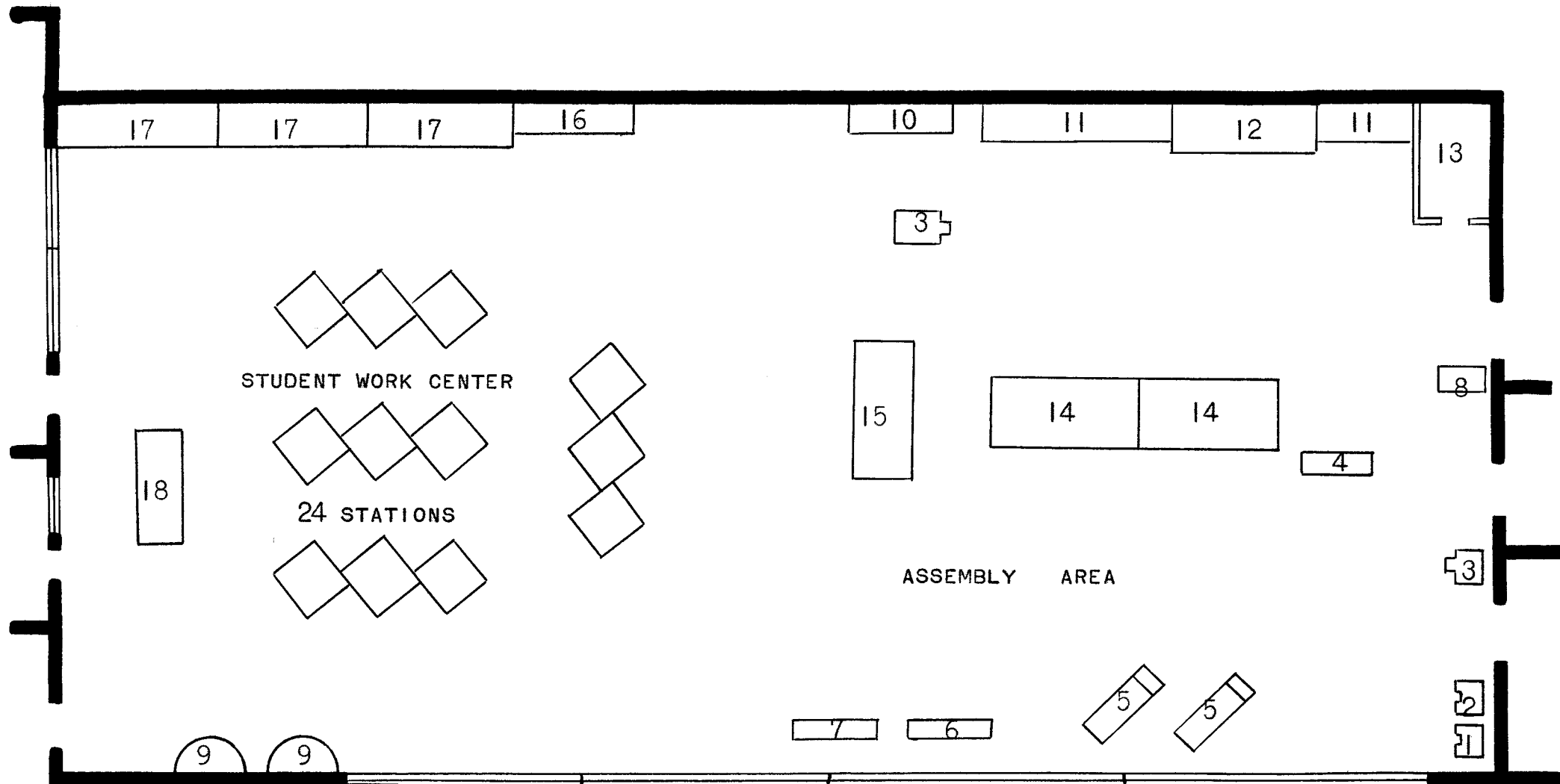
CARMICHAEL JUNIOR HIGH SCHOOL



APPENDIX D

EQUIPMENT PLACEMENT

GENERAL METAL AREA



- | | | | |
|------|-------------------|---------------------------|-------------------------|
| KEY: | 1. GRINDER | 7. METAL BRAKE | 13. WIRING BOOTH |
| | 2. BUFFER | 8. POWER HACK SAW | 14. SHEET METAL BENCH |
| | 3. DRILL PRESS | 9. WASH STATION | 15. SOLDERING BENCH |
| | 4. SQUARING SHEAR | 10. ELECTRICAL STORAGE | 16. TOOL PANEL |
| | 5. METAL LATHE | 11. WIRING BOARD | 17. PROJECT STORAGE |
| | 6. BAR FOLDER | 12. ELECTRICAL TEST BENCH | 18. DEMONSTRATION BENCH |