

A STUDY OF STANDARDS FOR INDUSTRIAL ARTS HOUSING
FACILITIES WITH PROPOSALS FOR HOUSING
FACILITIES FOR INDUSTRIAL ARTS AT
ARLINGTON HEIGHTS SENIOR HIGH
SCHOOL, FORT WORTH, TEXAS

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CHAPTER I

THE PROBLEM AND THE PROCEDURE

Introduction

The ideal industrial arts building for a senior high school in a particular locality probably has never been built. So many intricate and conflicting factors are involved in the planning of an ideal building that the chances are small that an ideal building can be constructed.

Prominent among the factors contributing to this unfortunate situation is the short-sightedness of citizens who are unwilling to be taxed in order to provide for the coming generations the best with respect to educational opportunity. Then, again, a wealthy and liberal school community with the very best of intentions may employ a well-meaning local architect who has received inadequate preparation in the area of schoolhouse planning. On the other hand the wealthy community may employ an architect of considerable reputation as a general architect but who is not a specialist in the area of schoolhouse design and who is unwilling to seek the advice of an expert in an advisory capacity. These and other factors, such as drives for public economy and the lack of easily available and unbiased reference material, frequently lead to poor schoolhouse planning.

Many people remember the somber, wooden-frame building of several stories with a scarcity of windows, dark interiors, steep staircases, and lockerless halls with the industrial arts classrooms located in the basement. Even today many architects still insist on locating the industrial arts shops in a semi-basement room where there is limited possibility for proper ventilation and lighting.

The Arlington Heights Senior High School, Fort Worth, Texas, is a three-year senior high school located in the southwestern section of the city. At the present time, Arlington Heights Senior High School receives its student body from the W. C. Stripling Junior High School, and effective with the school year of 1952-1953 it will also receive students from the new Monnig Junior High School which is located in the same section of the city. The W. C. Stripling Junior High School and the Monnig Junior High School receive their student bodies from six elementary schools. The average annual scholastic population of the Arlington Heights Senior High School for the period from 1940 to (and including) 1950 was 750 students.

At the time of purchase in 1935, the 31.732 acres of land which comprise the present school grounds were located in a sparsely-populated section of Fort Worth.¹ Since that

¹Personal interview with Elden Busby, Assistant Superintendent of Schools in Charge of Public Relations, Fort Worth, Texas, August, 1951.

time, however, many changes have occurred. The once sparsely-populated area is now a thriving community composed of upper middle-class families who send their children to the Arlington Heights Senior High School.

The present Arlington Heights Senior High School building is a beautiful, modern brick and tile building constructed entirely of fire-resistant materials. The building was planned to accommodate 750 students, but because of the unexpected increase in the scholastic population, the capacity of the building has become inadequate and can no longer adequately serve the scholastic population.

In a recent survey conducted for the Board of Education by Elden Busby, Assistant Superintendent of Schools, and Roy Stone, Principal of the Arlington Heights Senior High School, it was estimated that the scholastic population of this school district during the school year of 1963-1964 will be 1543. This rapid increase in the scholastic population, both current and estimated, has prompted the Board of Education to consider the necessity for providing additional housing facilities.

Statement of the Problem

This is a study of the standards and current practices as related to housing facilities for industrial arts programs with recommendations concerning the proposed housing facilities for industrial arts in the Arlington Heights

Senior High School, Fort Worth, Texas, based upon present and future estimated scholastic enrollment and accepted standards and practices.

Reasons Why the Study Should Be Made

The reasons why the study should be made are as follows:

1. The Board of Education of the Fort Worth Public Schools, Fort Worth, Texas, has made plans to enlarge the present building which houses the Arlington Heights Senior High School in order to provide for future increases in enrollment.

2. The present plans include the relocation of the industrial arts shops in a new addition which is to be attached to the present structure.

3. At the present time woodwork and metal work are taught on the unit basis and are taught in the same room. A study should be made to determine whether or not there should be a continuation of the present organization with respect to these two phases of the industrial arts program and whether or not separate housing facilities would be desirable for each of these particular phases of industrial arts.

4. It is believed necessary to study the proposed building program in order to determine the standards with reference to schoolhousing which are conducive to good

health and good living for the student body of the Arlington Heights Senior High School.

5. There is also a need to study the present and proposed industrial arts program in order to determine the best possible arrangement of new housing facilities with respect to the location of rooms for a functional program.

6. There is a need to study the present and probable future scholastic population in order to determine the amount and kind of facilities which will be needed to care for the expected increase in enrollment in industrial arts.

Purpose of the Study

The purpose of this study is actually seven-fold. These purposes are as follows:

1. To review the literature in the field of schoolhousing in order to ascertain the recommended standards and practices with respect to housing facilities for industrial arts programs.

2. To review the literature in the field of schoolhousing in order to ascertain recommended standards with respect to the location of industrial arts buildings.

3. To study the literature and proposed courses of study in industrial arts to ascertain the kind of facilities needed to house a unit type of industrial arts program.

4. To review the literature in the field of schoolhousing to determine the recommended standards conducive to

good health and good living of the students involved in the program.

5. To review the literature in the field of schoolhousing in order to determine recommended standards with respect to location of industrial arts rooms in the main building.

6. To review the literature in the field of schoolhousing in order to ascertain the kind and amount of facilities needed and desirable in order to care for the expected increase in enrollment in industrial arts.

7. To make recommendations concerning housing facilities for industrial arts in the Arlington Heights Senior High School, Fort Worth, Texas, based upon the recommended standards and practices with respect to schoolhousing and the expected future enrollment in industrial arts.

Limitations of the Study

The study is limited to an investigation of the recommended standards for schoolhousing facilities for industrial arts programs and to a study of the needs of the Arlington Heights Senior High School, Fort Worth, Texas, with respect to providing adequate housing facilities for industrial arts.

Definition of Terms

It is very easy to confuse many of the terms which are pertinent to schoolhousing; it is necessary, therefore, to

define certain terms in order that the concepts involved will not be misunderstood. These terms are defined as follows:

"Industrial Arts" has been defined as follows:

Industrial arts is a phase of general education that concerns itself with the materials, processes, and products of manufacture, and with the contribution of those engaged in industry. The learning comes through the pupil's experience with tools and materials and through his study of resultant conditions of life.²

The term "Unit or Course" as used in this study refers to a unit of work in wood, metal, or drawing, and usually includes one semester of work.

"Curriculum" refers to an organized program of study and as used in this study includes all of the units in woodwork, metal, and drawing.

For the purpose of this study the term "Standard" refers to that which has been established and accepted by authority as a rule, model, or example and used as a criterion of measure.

The term "Housing Facilities" as used in this study refers to that part of the building which houses the industrial arts woodwork, metal work, and mechanical drawing shops.

²United States Office of Education, Industrial Arts: Its Interpretation in American Schools, Bulletin No. 34, p. 1.

Sources of Data

Information concerning schoolhousing standards was secured from books, magazine articles, and pamphlets of a professional nature pertaining to the field of schoolhouse construction. The data concerning the scholastic population and trends in scholastic population presented in this study were obtained from the Arlington Heights Senior High School annual reports to the Southern Association of Colleges and Secondary Schools. Some additional data were obtained from interviews with administrative personnel and members of the Board of Education of the Fort Worth Independent School District, Fort Worth, Texas.

Organization of the Study

The study is organized as follows:

Chapter I includes an introduction, the statement of the problem, justification of the study, purpose of the study, limitations of the study, definition of terms, sources of data, organization of the study, and related studies.

The recommended standards developed and recommended by various committees and authorities in the area of schoolhousing were examined. These standards were presented in table form in order to show the extent of agreement by the various authorities with respect to each standard. These are presented in Chapter II.

In Chapter III data concerning the total scholastic

enrollment during the 1950-1951 school year and the estimated scholastic enrollment for the 1963-1964 school year were presented and compared with the total enrollment in industrial arts during the school year of 1950-1951 in order to ascertain the expected enrollment in industrial arts during the 1963-1964 school year.

Chapter IV treats the present and proposed industrial arts programs based upon recommendations of the industrial arts administrative staff and the Board of Education.

Chapter V presents recommendations concerning housing facilities for the industrial arts program based upon the recommended standards and the future enrollment in industrial arts and the proposed future industrial arts program.

Chapter VI includes the summary, conclusions, and recommendations of the study.

Related Studies

Several studies have been made which were concerned with one or more areas of schoolhousing for industrial arts. No single study was found which included all of the areas of housing facilities which are involved in the Arlington Heights Senior High School housing program concerning industrial arts.

A study of the lighting in the industrial arts shops in the Fort Worth Independent School District, Fort Worth, Texas, was made by Marvin D. King in 1951. The purpose of

the study was to determine the extent to which the lighting in the industrial arts shops of the Fort Worth public schools met recognized standards for school lighting. Of the seventeen industrial arts shops which were studied, only 4 per cent did not meet the recommended standards established by the Illuminating Engineering Society of America. The lack of good illumination was found to exist more in the finishing rooms and in the store rooms. Very few of these rooms had natural light coming into them, and artificial illumination had to be depended upon entirely. The Arlington Heights Senior High School industrial arts shop was among those rated as having sufficient illumination.³

At Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma, in 1950, a study was made by Earle B. Blanton concerning recommended standards for housing facilities which included such phases as lighting, heating, ventilation, health, storage and lockers, and the location and size of industrial arts shops. Recommended standards developed from current literature were suggested for use in planning new and remodeling old buildings.⁴

³Marvin D. King, "A Study of the Lighting Conditions in the Fort Worth Public Schools" (Unpublished Master's thesis, Department of Industrial Arts, North Texas State College, Denton, Texas, 1951).

⁴Earle B. Blanton, "Standards and Suggestions for the Planning, Construction, and Equipping of Elementary, Junior and Senior High Schools, and Junior College Industrial Arts Shops" (Unpublished Report, Department of Engineering Shopwork and Industrial Arts, Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma, 1950).

In 1943 Roy Crites made a study of housing facilities for industrial arts at the University of California. The purpose of the study was to compile recommended standards. Crites compiled the following standards:

<u>Building</u>	<u>Recommendations</u>
1. Site	Accessible to street outlets.
2. Location	On ground level, and if possible in a shop annex building.
3. Room Size	
Wood	1200 to 3500 square feet.
Metal	1200 to 3500 square feet.
Drafting	1000 to 2000 square feet.
4. Floor	
Space	
Wood	Never less than 50 square feet per pupil and might range upward to 100 square
Metal	feet. No definite recommendation.
Drafting	
5. Floors	
Wood	Maple or other woods, end grain wood
Drafting	blocks.
Metal	Concrete, asphalt, tile, or wood.
6. Ceiling	14 feet or more in all shops. Ceiling
Height	materials should reflect 75 per cent
	of light which strikes it.
7. Walls	No definite recommendations.

8. Windows Glass area not less than 18 per cent of floor area. Glass may start 3 feet above floor and go as near ceiling as possible. Windows should never be placed at rear of room, and at right or in front of pupils in class room.
9. Doors At least two outlets, with one over-size for removal of large projects and pieces of equipment. OPENING 6' X 4'. Two 3'2" wide X 7' doors.
10. Heating and Ven-tilation 10 to 30 cubic feet of air per pupil per minute. Temperature 58 degrees to 60 degrees Fahrenheit, with a cooling power of 8.0 being maintained in all parts of the room.
11. Lighting
- | | |
|----------|--|
| Wood | 15 to 25 foot candle or as near as possible. |
| Metal | sible. |
| Drafting | 25 to 50 foot candle or as near as possible. |
| Lights | Lights should be handled on two or more circuits so lights may be shut off as desired. Extra power circuit should be installed for future need. Copper wire heavy enough to handle all loads is recommended. |

12. Lighting
for
Lockers,
Stairways,
Storage Room,
Dressing Room,
Shower Room,
Toilets
- Should have 4 foot candle and might be more if there is a need.
13. Lighting for Office,
Library,
Tool Room,
Lumber Room
- No definite recommendations, but there were indications that these rooms should have more light than that listed above.
14. Tool Room
- Centrally located, large enough to handle particular shop. Should be suitable for storage of wood or metal tools.
15. Outlets
- Gas, water, electricity, air, and exhaust should, if possible, run overhead where they can be dry and accessible.
16. Lavatories and Lockers
- Should be ample and spaced so as to prevent crowding.

- | | |
|---------------------------|---|
| 17. Dressing
Room | Size and dimensions were not given. |
| 18. Toilets | One for each 25 boys in class. |
| 19. Washing
Facilities | No definite recommendations. |
| 20. Office | Should be a glassed-in room, viewing
the entire shop, furnished properly. |
| 21. Library | May be housed in the office, or in-
corporated in the building plan. |
| 22. Lumber
Room | Should have ample space; it should
have temperature control devices. |
| 23. Storage Room | For unfinished personal belongings. |
| 24. Wall Lockers | For storing personal belongings. |
| 25. Exhaust
System | To office, glue room, tool room, and
finishing room. There should be an
exhaust to each machine that cuts wood. |
| 26. Incinerator | As near shop as possible to handle
exhaust from wood machines. |
| 27. Insulation | Should be used in walls and floors to
eliminate noises as much as possible. |
| 28. Drains | No definite recommendations. |
| 29. Drinking
Fountain | No definite recommendations. ⁵ |

⁵Roy V. Crites, "Study in Design for an Industrial Arts Building, Los Angeles, California" (Unpublished Master's thesis, Department of Education, University of California, 1943), pp. 10-175.

A study of the housing facilities provided for industrial arts in the junior high schools of seven Panhandle counties in Texas was made by Richard G. Strickland in 1952. The purpose of the study was to review professional literature pertaining to adequate housing facilities for industrial arts and to ascertain the extent to which the housing facilities provided for industrial arts in the schools included in the study met the recommended standards. It was found from the data presented in this study that the eleven schools located in the Panhandle counties of Texas partially met the recommended standards for schoolhousing as established by authorities in this field and that there is much to be done and many improvements to be made if the housing facilities for the various industrial arts programs of the eleven schools are to meet recognized standards for schoolhousing.⁶

⁶Richard G. Strickland, "A Study of the Housing Facilities Provided for Industrial Arts in the Junior High Schools of Seven Panhandle Counties" (Unpublished Master's thesis, Department of Industrial Arts, North Texas State College, Denton, Texas, 1950).

CHAPTER II

CURRENT STANDARDS AND RECOMMENDATIONS CONCERNING HOUSING FACILITIES FOR INDUSTRIAL ARTS PROGRAMS

The planning of high school industrial arts shops rarely proceeds without reference to definite standards or criteria. These criteria should be sufficiently comprehensive to cover all aspects of schoolhouse planning. No phase of the planning should be left to chance or go by default because of insufficient study.

One of the purposes of this study is to review and present standards and specifications which are regarded as pertinent to housing facilities for industrial arts and which are suitable for one specific school community located in the Fort Worth Independent School District, namely the Arlington Heights Senior High School. The standards which will be presented have been developed by recognized authorities in the field of schoolhousing. After a thorough study of the many features involved in building a school plant had been made, seven authorities recognized in the field of schoolhousing were arbitrarily selected, and the standards which they have developed and recommended were used to formulate a set of standards to be used in the planning of the housing facilities for industrial arts.

The seven authorities selected are widely known in the fields of schoolhousing and industrial arts. They are as follows: Arthur B. Mays, who is presently Professor of Industrial Education, and Carl H. Casberg, who is Professor of Mechanical Engineering at the University of Illinois. Gordon O. Wilber was selected; he is the Director of the Division of Industrial Arts Teacher Education, State Teachers College, Oswego, New York. The National Council on Schoolhouse Construction was also selected; this is an organization which consists of persons working with school building programs. This organization is directed by a plant guide committee, which consists of Roy L. Hamon, Chief of Schoolhousing Section, Division of School Administration, United States Office of Education, Washington, D. C., who serves as chairman, George D. Strayer, Professor of Educational Administration, and Nicholous L. Engelhardt, Professor of Education at the Teachers College, Columbia University, Alanson D. Brainard, Assistant Superintendent of Schools, Dearborn, Michigan, Arden M. Stoneman, Professor of School Administration and Elementary Education, and Oscar K. Broady, Director of Extension and Professor of School Administration at the University of Nebraska, Lincoln, Nebraska. The publications entitled Architectural Record and The American School and University were also selected, because each contains articles and pertinent information concerning schoolhousing problems which has been written and published by

various persons considered to be authorities in this area of education.

Standards recommended by the foregoing authorities are presented in Tables 1 through 20. Table 1 and subsequent tables were constructed in order to show the degree to which the various authorities were in agreement on the several standards selected for consideration.

Recommendations Concerning Building Sites and the Location of Industrial Arts Shops

One of the first considerations in planning industrial arts housing is the building site and its location. The necessary servicing of industrial arts plants and programs emphasizes the need for easy access from the shop to the street. Heavy machinery and supplies are often moved into the shop, and bulky projects are frequently taken out.

Any project planned to last for many years should take into consideration the probable needs of later years. Therefore, the planning of an industrial arts shop should take into consideration the probable increase in the number of students in industrial arts courses and the probable changes in the courses themselves. As a result, the shops should be so located that new additions can be added at later dates.

The building site selected should have good drainage in order to insure better lasting strength of the structure and good exposures to add as much as possible to the comfort of the students. The location should permit the construction

of good service driveways to accommodate the student traffic to the shop from the streets. Table 1 presents recommendations by five authorities concerning the building site and the location of industrial arts shops.

TABLE 1
RECOMMENDATIONS CONCERNING BUILDING SITES
AND THEIR LOCATION FOR INDUSTRIAL
ARTS SHOPS

Desirable Features Concerning Building Sites and the Location of Industrial Arts Shops	Authorities Quoted				
	Mays and Casberg ¹	Wilber ²	American School and University ³	National Council on Schoolhouse Construction ⁴	Strayer and Engelhardt ⁵
1. The building should be accessible to the street.	Yes	Yes	*	Yes	Yes

¹Arthur B. Mays and Carl H. Casberg, School Shop Administration, pp. 8-32.

²Gordon O. Wilber, Industrial Arts in General Education, pp. 235-330.

³American School and University, Twenty-first Yearbook, pp. 34-220.

⁴National Council on Schoolhouse Construction, Guide for Planning School Plants, 1949 edition, pp. 56-166.

⁵G. D. Strayer and N. L. Engelhardt, Standards for High School Buildings, pp. 9-10.

TABLE 1--Continued

Desirable Features Concerning Building Sites and the Location of Industrial Arts Shops	Authorities Quoted				
	Mays and Casberg	Wilber	American School and University	National Council on Schoolhouse Construction	Strayer and Engelhardt
	Agrees with Recommendations				
2. The location should provide for flexibility for expansion.	Yes	Yes	Yes	*	Yes
3. The industrial arts shop building should be located away from the main building or in a separate wing of the building.	Yes	Yes	Yes	Yes	Yes
4. The building should have good drainage and exposures.	Yes	Yes	Yes	Yes	Yes
5. The location should provide good service drive-ways.	Yes	Yes	Yes	Yes	Yes
6. The location and structure should provide economical and easy maintenance services.	Yes	Yes	Yes	Yes	Yes
7. The shop should be located away from play areas.	*	*	Yes	Yes	Yes
8. The shop should be located so that it will be convenient for night use by adults.	Yes	*	*	*	*

*These authorities did not offer recommendations concerning these particular features.

Recommendations Concerning the Location of
Industrial Arts Shops with Reference
to the Main School Plant

There are certain desirable features with respect to the location of the industrial arts shop to the main school plant. Table 2 presents the recommendations of five authorities concerning the location of the shop with reference to the main building. The authorities agree that the industrial arts shops should be housed in a separate building if possible. In the event a separate building is not available, they agree that the ground floor of the main building is the most desirable location for the industrial arts shop. There is also agreement among the authorities in that each stated that locating the industrial arts shops in basements is undesirable.

Recommendations Concerning the Location of
Industrial Arts Shops in the Main
Building

Other factors also influence the location of the various wood, metal, and drawing shops within the building, regardless of whether they are located in a separate building or in the main school building. The authorities agree that the ground floor is the most desirable location for the wood shop, metal shop, and the drawing room. Some of the authorities believe that the drawing room can be located on the second floor, but they definitely should not be located in the basement. Table 3 includes recommendations concerning the location of industrial arts shops.

TABLE 2

RECOMMENDATIONS CONCERNING THE LOCATION OF
INDUSTRIAL ARTS SHOPS WITH REFERENCE
TO THE MAIN SCHOOL PLANT

Location of Industrial Arts Shops with Reference to the Main School Plant	Authorities Quoted				
	Mays and Casberg ⁶	Wilber ⁷	American School and University ⁸	National Council on Schoolhouse Construction ⁹	Strayer and Engelhardt ¹⁰
	Agrees with Recommendations				
1. The industrial arts shops should be housed in a separate building.	Yes	Yes	Yes	Yes	Yes
2. The industrial arts shops should be located on the ground floor of the main building.	Yes	Yes	Yes	Yes	Yes

⁶Mays and Casberg, op. cit., p. 28.

⁷Wilber, op. cit., pp. 253-255.

⁸American School and University, Twenty-first Yearbook,

⁹National Council on Schoolhouse Construction, op. cit., pp. 56-166.

¹⁰Strayer and Engelhardt, op. cit., pp. 55-56.

TABLE 3

RECOMMENDATIONS CONCERNING THE LOCATION OF INDUSTRIAL
ARTS SHOPS IN THE MAIN BUILDING

Location of Industrial Arts Shops in the Building	Authorities Quoted				
	Mays and Casberg ¹¹	Architectural Record ¹²	<u>American School and University</u> ¹³	National Council on Schoolhouse Construction ¹⁴	Strayer and Engelhardt ¹⁵
	Preference of Location				
1. The wood shop should be located:					
A. In the basement	No	No	No	No	No
B. On the ground floor	Yes	Yes	Yes	Yes	Yes
C. On the second floor	No	No	No	No	No
2. The metal shop should be located:					
A. In the basement	No	No	No	No	No
B. On the ground floor	Yes	Yes	Yes	Yes	Yes
C. On the second floor	No	No	No	No	No
3. The drawing room should be located:					
A. In the basement	No	No	No	No	No
B. On the ground floor	Yes	Yes	Yes	Yes	Yes
C. On the second floor	May	May	May	May	May

¹¹Mays and Casberg, op. cit., pp. 27-32.

¹²Arthur B. Mays, "The School Shop for General Education," Architectural Record, C (July, 1946), 94-100.

¹³American School and University, Twenty-Second Yearbook, pp. 313-336.

¹⁴National Council on Schoolhouse Construction, op. cit., pp. 66-68.

¹⁵Strayer and Engelhardt, op. cit., pp. 55-63.

Recommendations Concerning the Amount of Floor Area for Industrial Arts Shops

One of the factors which influences the working efficiency of the industrial arts shop is that of the amount of square feet of floor area per pupil. Table 4 shows the various amounts of floor area believed to be necessary by each of the industrial arts housing authorities, as well as the minimum amount of floor area per pupil considered adequate and the amount of floor area considered as desirable. The five authorities did not agree in their individual recommendations concerning the amount of floor space; in their recommendations the amount ranged from a minimum of fifty square feet per pupil in all shops to a maximum of 125 square feet per pupil.

Recommendations Concerning the Design and Proportion of Industrial Arts Shops

Some of the factors affecting the working efficiency of industrial arts shops are design and proportion. Table 5 contains the recommendations of the five authorities concerning the design, proportion, and shape of industrial arts shops. These authorities unanimously recommend a rectangular-shaped room with the proportions of approximately 1:1.5 to 2; a room which is square in shape is not acceptable, according to these authorities. They also agree that any room with obstructed vision, such as an "L-shaped" or "U-shaped" room, is undesirable.

TABLE 4

RECOMMENDATIONS CONCERNING THE AMOUNT OF
FLOOR AREA FOR INDUSTRIAL ARTS SHOPS

Amount of Square Feet of Floor Area per Pupil for Industrial Arts Shops	Authorities Quoted				
	Mays and Casberg ¹⁶	Wilber ¹⁷	<u>American School and University</u> ¹⁸	National Council on Schoolhouse Construction ¹⁹	Strayer and Engelhardt ²⁰
	Number of Square Feet Per Pupil Recommended				
1. Minimum amount of floor area per pupil in:					
A. Wood shop	50	60	75	50-75	50
B. Metal shop	50	60	75	50-75	50
C. Drawing room	50	60	75	50-75	50
2. Adequate amount of floor area per pupil in:					
A. Wood shop	75	75	100	75	75
B. Metal shop	75	75	100	75	75
C. Drawing room	75	75	100	75	75
3. Desirable amount of floor area per pupil in:					
A. Wood shop	70	75	125	75	75
B. Metal shop	70	75	125	75	75
C. Drawing room	70	75	125	75	75

¹⁶Mays and Casberg, op. cit., pp. 8-46.

¹⁷Wilber, op. cit., pp. 254-300.

¹⁸American School and University, Twenty-Second Yearbook,
pp. 316-320.

¹⁹National Council on Schoolhouse Construction, op. cit.,
pp. 71-85.

²⁰Strayer and Engelhardt, op. cit., pp. 55-64.

TABLE 5

RECOMMENDATIONS CONCERNING THE DESIGN AND
PROPORTION OF INDUSTRIAL ARTS SHOPS

Desirable Features Concerning the Design, Proportion, and Size of Industrial Arts Shops	Authorities Quoted				
	Mays and Casberg ²¹	Wilber ²²	American School and University ²³	National Council on Schoolhouse Construction ²⁴	Strayer and Engelhardt ²⁵
	Agrees with Recommendations				
1. The room should be approximately 1:1.5 to 2 in size.	Yes	Yes	Yes	*	Yes
2. The room should be rectangular in shape.	Yes	Yes	Yes	Yes	Yes
3. The room should be square in shape.	No	No	No	No	*
4. A room designed to resemble the letter "L" is very desirable.	*	No	No	*	*
5. Room design resembling the letter "T" or "U" is undesirable.	*	Yes	Yes	*	*
*Authority did not make a recommendation.					

²¹Mays and Casberg, op. cit., pp. 9-15.

²²Wilber, op. cit., pp. 253-258.

²³American School and University, Twenty-Second Yearbook, pp. 217-220.

²⁴National Council on Schoolhouse Construction, op. cit., p. 71.

²⁵Strayer and Engelhardt, op. cit., pp. 55-62.

Recommendations Concerning Auxiliary Rooms in Industrial Arts Shops

The recommendations in Table 6 emphasize the need of providing adequate auxiliary rooms for wood, metal, and mechanical drawing. All of the authorities quoted in this study agree that the size of the office, the tool rooms, the finishing room, the supply rooms, the library, and the locker and washroom should be in proportion to the number of square feet of floor area allotted each student. The authorities did not give specific recommendations in terms of square feet.

Recommendations Concerning the Illumination of Industrial Arts Shops

A factor in industrial arts housing which influences the health and safety of the pupils, as well as directly affecting the working efficiency of the students, is that of illumination. Table 7 lists the desirable amount of illumination recommended for the rooms in which wood, metal, and drawing are taught. The recommended amount of light varied from twelve to fifteen foot candles per square foot for wood and metal shops to fifty foot candles per square foot. All of the authorities recommend a greater amount of light for drawing rooms. The amount of foot candle power of light per square foot recommended for drawing rooms varied from a minimum of eighteen to twenty foot candle power to a maximum of sixty foot candles.

TABLE 6
RECOMMENDATIONS CONCERNING AUXILIARY ROOMS
IN INDUSTRIAL ARTS SHOPS

Space Allowed for the Wood, Metal, and Drawing Auxiliary Rooms Should Be in Proportion to the Number of Square Feet of Shop Area per Pupil	Authorities Quoted				
	Mays and Casberg ²⁶	Wilber ²⁷	American School and University ²⁸	National Council on Schoolhouse Construction ²⁹	Strayer and Engelhardt ³⁰
Auxiliary Rooms	Authority Agrees on Proportional Space				
1. Office	Yes	Yes	Yes	Yes	Yes
2. Tool room	Yes	Yes	Yes	Yes	Yes
3. Finishing room	Yes	Yes	Yes	Yes	Yes
4. Supply room	Yes	Yes	Yes	Yes	Yes
5. Storage room	Yes	Yes	Yes	Yes	Yes
6. Library	Yes	Yes	Yes	Yes	Yes
7. Locker and wash room	Yes	Yes	Yes	Yes	Yes

²⁶Mays and Casberg, op. cit., pp. 9-15.

²⁷Wilber, op. cit., pp. 253-258.

²⁸American School and University, Twenty-Second Yearbook, pp. 313-336.

²⁹National Council on Schoolhouse Construction, op. cit., pp. 66-72.

³⁰Strayer and Engelhardt, op. cit., pp. 55-62.

TABLE 7

RECOMMENDATIONS CONCERNING THE ILLUMINATION, IN TERMS
OF FOOT CANDLES, FOR INDUSTRIAL ARTS SHOPS

Phases of Industrial Arts	Authorities Quoted				
	Mays and Casberg ³¹	Wilber ³²	American School and University ³³	National Council on Schoolhouse Construction ³⁴	Strayer and Engelhardt ³⁵
	Recommended Amount of Illumination in Terms of Foot Candles				
1. Woodwork	12-15	30	30	20-40	50
2. Metal work	12-15	30	30	20-40	50
3. Mechanical drawing	18-20	45-50	50	60	60

Recommendations Concerning the Illumination of
Auxiliary Rooms in Industrial Arts Shops

Perhaps of lesser importance, but still an important consideration, is the amount of illumination in the auxiliary rooms which serve the industrial arts shops. Table 8 presents

³¹Mays and Casberg, op. cit., p. 23.

³²Wilber, op. cit., pp. 288-292.

³³American School and University, Twenty-Second Yearbook, pp. 313-336.

³⁴National Council on Schoolhouse Construction, op. cit., p. 143.

³⁵Strayer and Engelhardt, op. cit., pp. 33-34.

recommended standards concerning the amount of candle power for auxiliary rooms.

TABLE 8
RECOMMENDATIONS CONCERNING THE ILLUMINATION OF
AUXILIARY ROOMS IN INDUSTRIAL ARTS SHOPS

Auxiliary Rooms Usually Connected with Indus- trial Arts Shops	Authorities Quoted				
	Mays and Casberg ³⁶	Wilber ³⁷	American School and University ³⁸	National Council on Schoolhouse Construction ³⁹	Strayer and Engelhardt ⁴⁰
	Amount of Light Recommended in Terms of Foot Candles per Square Foot				
1. Offices	12-15	30	30	20-40	30
2. Tool rooms	12-15	30	30	20-40	10
3. Finishing rooms	13-15	*	50	60	30
4. Lumber and metal storage rooms	*	*	10	*	10
5. Project storage rooms	*	*	5	*	10
6. Locker and wash rooms	*	*	*	*	5
*Authority did not give recommended amount of light.					

³⁶Mays and Casberg, op. cit., pp. 33-34.

³⁷Wilber, op. cit., pp. 288-292.

³⁸American School and University, Twenty-Second Yearbook, pp. 316-336.

³⁹National Council on Schoolhouse Construction, op. cit., p. 134.

⁴⁰Strayer and Engelhardt, op. cit., pp. 33-34.

The authorities suggest a minimum of twelve to fifteen candle power for offices and tool rooms and a maximum of thirty to forty candle power for finishing rooms. They also recommend from eighteen to twenty-five foot candles of light as a minimum and sixty foot candles of light as a maximum for lumber and metal storage rooms, project storage rooms, locker rooms, and at least from five to ten foot candles of light for washrooms.

Recommendations Concerning the Electrical Wiring of Industrial Arts Shops

Table 9 presents recommendations concerning construction and safety features of the electrical wiring system of industrial arts shops. The authorities recommend that all circuits should be controlled from one centralized box. They also recommend that emergency switches should be connected to the main line and that they should be located at regular intervals within the shop. It is also recommended as desirable to provide service outlets for 110 and 220 volts to be located at nine to ten foot intervals around the interior walls of the shop and that the service outlets for 110 and 220 volts should be placed from thirty to forty inches above the floor. Standard mercury switches are recommended for use in finishing rooms and on all machines. Overhead outlet boxes should be installed to serve the small movable machines, and outlet boxes should be installed at designated locations in the floor to serve heavy, stationary machines.

TABLE 9

RECOMMENDATIONS CONCERNING THE ELECTRICAL WIRING
SYSTEMS OF INDUSTRIAL ARTS SHOPS

Recommendation Pertaining to the Electrical Wiring of Industrial Arts Shops	Authorities Quoted				
	Mays and Casberg ⁴¹	Wilber ⁴²	American School and University ⁴³	National Council On Schoolhouse Construction ⁴⁴	Architectural Record ⁴⁵
	Agrees with Recommendations				
1. All circuits should be controlled from one centralized box.	*	Yes	Yes	*	Yes
2. Emergency switches connected to the main line should be located at regular intervals around the shop.	*	Yes	Yes	*	*
3. Service outlets for 110 volts and 220 volts should be located at 9 to 10 foot intervals around the shop.	Yes	Yes	Yes	Yes	Yes

⁴¹Mays and Casberg, op. cit., pp. 8-31.

⁴²Wilber, op. cit., pp. 287-309.

⁴³American School and University, Twenty-Second Yearbook, pp. 316-336.

⁴⁴National Council on Schoolhouse Construction, op. cit., pp. 66-71.

⁴⁵Arthur B. Mays, "The School Shop for General Education," Architectural Record, C (July, 1946), 94-100.

TABLE 9--Continued

Recommendation Pertaining to the Electrical Wiring of Industrial Arts Shops	Authorities Quoted				
	Mays and Casberg	Wilber	<u>American School and University</u>	National Council on Schoolhouse Construction	<u>Architectural Record</u>
	Agrees with Recommendations				
4. Service outlets for 110 and 220 volts should be 30 inches to 40 inches above the floor.	Yes	Yes	*	*	Yes
5. Standard mercury switches should be installed in the finishing room and on all machines.	Yes	Yes	Yes	Yes	*
6. Overhead outlet boxes should be installed to serve the small movable machines.	*	*	Yes	*	*
7. Outlet boxes should be installed at designated locations in the floor to serve heavy, unmovable machines.	*	Yes	*	*	Yes

*Authority did not make recommendations concerning items indicated.

Recommendations Concerning the Ventilation of Industrial Arts Shops

Recommendations concerning another factor affecting the working efficiency of the students in industrial arts shops are presented in Table 10.

TABLE 10
 RECOMMENDATIONS CONCERNING THE VENTILATION
 OF INDUSTRIAL ARTS SHOPS

Shops in Which Different Phases of Industrial Arts Are Taught	Authorities Quoted				
	Mays and Casberg ⁴⁶	<u>Architectural Record</u> ⁴⁷	<u>American School and University</u> ⁴⁸	National Council on Schoolhouse Construction ⁴⁹	Strayer and Engelhardt ⁵⁰
	Number of Cubic Feet of Fresh Air Recommended per Minute per Pupil				
1. Woodwork	7-25	6-7.5	7-25	15	30
2. Metal work	7-25	6-7.5	7-25	15	30
3. Mechanical drawing	7-25	6-7.5	7-25	15	30

Table 10 also includes the desirable recommended number of cubic feet of fresh air per minute per pupil in industrial arts shops. The recommended amounts vary from a minimum of

⁴⁶Mays and Casberg, op. cit., p. 26.

⁴⁷Arthur B. Moehlman, "New Facilities for Industrial Arts Training," Architectural Record, LXXXVII (April, 1940), 96-100.

⁴⁸American School and University, Twenty-Second Yearbook, pp. 313-336.

⁴⁹National Council on Schoolhouse Construction, op. cit., pp. 130-138.

⁵⁰Strayer and Engelhardt, op. cit., p. 27.

seven to twenty-five feet of fresh air per minute per pupil in wood and metal shops and drawing rooms to a maximum of thirty cubic feet of fresh air per minute per pupil.

Recommendations Concerning the Ventilation of Auxiliary Rooms in Industrial Arts Shops

The information contained in Table 11 is closely related to that included in Table 10. The recommendations concerning ventilation for auxiliary rooms in industrial arts shops are presented in Table 11. The desirable amount of air change per minute varies in terms of cubic feet per minute per pupil from seven to twenty-five cubic feet in offices, tool rooms, finishing rooms, lumber and metal storage rooms, project storage rooms, and locker and washroom. The authorities were in complete agreement concerning this phase of schoolhousing.

Recommendations Concerning the Heating of Auxiliary Rooms in Industrial Arts Shops

Recommendations concerning heating are included in Table 12. The recommended temperature for the wood and metal shop and for drawing rooms ranged from sixty to seventy degrees. The recommended temperature range was from sixty-five to seventy degrees for offices, tool rooms, lumber and metal storage rooms, and project storage rooms. For the finishing rooms, three of the housing authorities recommended that a temperature of seventy-eight degrees be maintained and for locker and washrooms that a temperature of seventy-five to eighty degrees be maintained.

TABLE 11
 RECOMMENDATIONS CONCERNING THE VENTILATION
 OF AUXILIARY ROOMS

	Authorities Quoted				
	Mays and Casberg ⁵¹	<u>Architectural Records</u> ⁵²	<u>American School and University</u> ⁵³	National Council on Schoolhouse Construction ⁵⁴	Strayer and Engelhardt ⁵⁵
There Should Be an Air Change Ranging from 7 to 25 Cubic Feet Per Minute Per Student in Each of the Following					
	Authority Agrees with the Recommended Amount Ranging from 7 to 25 Cubic Feet Per Minute				
1. Office	Yes	Yes	Yes	Yes	Yes
2. Tool rooms	Yes	Yes	Yes	Yes	Yes
3. Finishing rooms	Yes	Yes	Yes	Yes	Yes
4. Lumber and metal storage rooms	Yes	Yes	Yes	Yes	Yes
5. Project storage rooms	Yes	Yes	Yes	Yes	Yes
6. Locker and wash rooms	Yes	Yes	Yes	Yes	Yes

⁵¹Mays and Casberg, op. cit., pp. 26-27.

⁵²Moehlman, op. cit., pp. 96-100.

⁵³American School and University, Twenty-Second Yearbook, pp. 313-336.

⁵⁴National Council on Schoolhouse Construction, op. cit., pp. 130-138.

⁵⁵Strayer and Engelhardt, op. cit., pp. 27-30.

TABLE 12

RECOMMENDATIONS CONCERNING THE HEATING OF INDUSTRIAL
ARTS SHOPS AND AUXILIARY ROOMS

Main Rooms and Auxiliary Rooms to Be Heated in Industrial Arts Shops	Authorities Quoted				
	<u>Architectural Record</u> ⁵⁶	Stoneman, Broady, and Brainard ⁵⁷	<u>American School and University</u> ⁵⁸	National Council on Schoolhouse Construction ⁵⁹	Strayer and Engelhardt ⁶⁰
	Recommended Temperature Range in Terms of Fahrenheit Scale				
1. Wood shop	60-65	66-70	60-68	60-68	65-70
2. Metal shop	60-65	66-70	60-68	60-68	65-70
3. Mechanical drawing room	60-70	66-70	66-70	60-68	65-70
4. Office	70	68-72	68-74	70	65-70
5. Tool rooms	65	*	68-70	68	65
6. Finishing rooms	*	*	78	78	78
7. Lumber and metal storage room	65	*	68-70	*	65
8. Project storage room	65	*	*	*	*
9. Locker and washroom	75	76-80	78	78	75-80

*Authority did not make recommendation concerning temperature.

⁵⁶Moehlman, op. cit., pp. 96-100.

⁵⁷M. M. Stoneman, K. O. Broady, and A. D. Brainard, Planning and Modernizing the School Plant, p. 212.

⁵⁸American School and University, Twenty-Second Yearbook, pp. 313-336.

⁵⁹National Council on Schoolhouse Construction, op. cit., pp. 130-131.

⁶⁰Strayer and Engelhardt, op. cit., pp. 29-31.

**Recommendations Concerning Locker and Washroom
Facilities in Industrial Arts Shops**

The recommendations presented in Table 13 concern the amount of desirable locker and washroom facilities.

TABLE 13

**RECOMMENDATIONS CONCERNING LOCKER AND WASHROOM
FACILITIES IN INDUSTRIAL ARTS SHOPS**

	Authorities Quoted				
	<u>Architectural Record</u> ⁶¹	Engelhardt, and Leggett ⁶²	<u>American School and University</u> ⁶³	National Council on Schoolhouse Construction ⁶⁴	Strayer and Engelhardt ⁶⁵
Washroom Facilities in Industrial Arts Shops					
	Amount of Facilities Needed Based upon Classes of 24 Students				
1. Closets	1	1	*	1	1
2. Urinals	1	1	*	1	1
3. Wash basins	1	1	1	1	1
4. Showers	1	*	*	1	1
5. Drinking fountains	1	*	1	1	1

*Authority did not state recommendation.

⁶¹Arthur B. Mays, "The School Shop for General Education," Architectural Record, C (July, 1946), 94-100.

⁶²N. L. Engelhardt, N. L. Engelhardt, Jr., and Stanton Leggett, Planning Secondary School Buildings, pp. 197-199.

⁶³American School and University, Twenty-Second Yearbook, pp. 313-336.

⁶⁴National Council on Schoolhouse Construction, op. cit., pp. 154-185.

⁶⁵Strayer and Engelhardt, op. cit., pp. 37-41.

The amount of actual facilities recommended for lockers and washrooms in industrial arts shops was based on a class enrollment of twenty-four students. Three of the authorities recommend one closet, one urinal, one wash basin, one shower, and one drinking fountain for each twenty-four students. Another authority suggests only one closet, one urinal, and one wash basin for each twenty-four students; one authority recommends only one wash basin and one drinking fountain.

Recommendations Concerning Corridors, Outside, and Inside Exits Serving Industrial Arts Shops

Recommendations related to efficient traffic control are included in Table 14. This feature of an industrial arts building is dependent upon the corridors and outside and inside exits serving the industrial arts shops. Desirable traffic features include corridors which are from eight to twelve feet wide to service the industrial arts shop. The authorities recommend that at least two exits to the industrial arts shops be provided, with the exit into the main corridor being at least thirty-six inches wide. They also recommend that all doors used in connection with each exit should swing with the exit. Locks on all doors should require no keys to open them from the inside. There should also be at least one double-door exit provided to permit passage of large projects and large equipment. The exits should be readily accessible and unobstructed, as well as suitably lighted.

TABLE 14

RECOMMENDATIONS CONCERNING CORRIDORS, OUTSIDE AND
INSIDE EXITS SERVING INDUSTRIAL ARTS SHOPS

Desirable Features Concerning Outside and Inside Exits and Corridors Serving Industrial Arts Shops	Authorities Quoted				
	<u>Architectural Record</u> ⁶⁶	Stoneman, Broady, and Brainard ⁶⁷	<u>American School and University</u> ⁶⁸	National Council on Schoolhouse Construction ⁶⁹	Strayer and Engelhardt ⁷⁰
	Authority Believed Each of These Features to Be Desirable				
1. The corridors serving the industrial arts shop should be from eight to twelve feet in width.	Yes	*	Yes	Yes	Yes
2. There should be at least two exits to the industrial arts shop.	*	*	Yes	Yes	Yes
3. The exit opening into the main corridor should be at least thirty-six inches wide.	Yes	*	Yes	Yes	*

⁶⁶Arthur B. Mays, "The School Shop for General Education," Architectural Record, C (July, 1946), 94-100.

⁶⁷Stoneman, Broady, and Brainard, op. cit., p. 307.

⁶⁸American School and University, Twenty-Second Yearbook, pp. 313-336.

⁶⁹National Council on Schoolhouse Construction, op. cit., pp. 120-123.

⁷⁰Strayer and Engelhardt, op. cit., pp. 19-40.

TABLE 14--Continued

Desirable Features Concerning Outside and Inside Exits and Corridors Serving Industrial Arts Shops	Authorities Quoted				
	<u>Architectural Record</u>	Stoneman, Broady, and Brainard	<u>American School and University</u>	National Council on Schoolhouse Construction	Strayer and Engelhardt
	Authority Believed Each of These Features to Be Desirable				
4. All doors used in connection with each exit should swing with exit.	*	*	Yes	*	Yes
5. Locks on all doors should require no keys to open from the inside of the shop.	Yes	*	Yes	Yes	*
6. There should be at least one double-door exit provided to permit passage of large projects and large equipment.	Yes	*	Yes	Yes	Yes
7. The exits should be readily accessible and unobstructed.	*	Yes	Yes	*	*
8. The exits should be suitably lighted.	*	Yes	Yes	Yes	*

*Authority did not make a recommendation.

Recommendations Concerning the Exterior and Interior Walls of Industrial Arts Shops

Recommendations of five authorities concerning the desirable features of exterior and interior walls for industrial

arts buildings are presented in Table 15. The outer wall should be of hard bricks laid in cement mortar. The outer wall construction should be planned so as to permit the re-location of the interior walls. The outer walls should be furred and waterproofed.

TABLE 15
RECOMMENDATIONS CONCERNING EXTERIOR AND INTERIOR
WALLS FOR INDUSTRIAL ARTS SHOPS

Desirable Features Concerning Interior and Exterior Walls for Industrial Arts Shops	Authorities Quoted				
	National Council on Schoolhouse Construction ⁷¹	Architectural Record ⁷²	American School and University ⁷³	Stoneman, Broady, and Brainard ⁷⁴	Strayer and Engelhardt ⁷⁵
1. The outer wall should be of hard brick laid in cement mortar.	Authority Agrees with Recommendation				
	*	Yes	Yes	*	Yes

⁷¹National Council on Schoolhouse Construction, op. cit., pp. 66-86.

⁷²Arthur B. Mays, "The School Shop for General Education," Architectural Record, C (July, 1946), 94-106.

⁷³American School and University, Nineteenth Yearbook, pp. 86-90.

⁷⁴Stoneman, Broady, and Brainard, op. cit., pp. 276-277.

⁷⁵Strayer and Engelhardt, op. cit., pp. 16-17.

TABLE 15--Continued

Desirable Features Concerning Interior and Exterior Walls for Industrial Arts Shops	Authorities Quoted				
	National Council on Schoolhouse Construction	Architectural Record	American School and University	Stoneman, Broady, and Brainard	Strayer and Engelhardt
	Authority Agrees with Recommendation				
2. The outer wall construction should be so planned as to permit the relocation of interior walls.	*	Yes	Yes	*	*
3. The outer walls should be furred and waterproofed.	Yes	*	Yes	*	Yes
4. The outer wall of the industrial arts shop should be a non-bearing wall to allow for ease of expansion.	*	*	*	Yes	*
5. The outer wall should not support all the weight of the roof.	*	*	*	Yes	*
6. The interior and non-bearing wall should be of hollow tile.	*	Yes	Yes	Yes	Yes
7. The interior wall should have a wainscoating of hard-finished tile.	*	Yes	Yes	*	*
8. The interior wall above the wainscoating should be a soft wall board material high in noise-absorption qualities.	Yes	Yes	Yes	Yes	*

*Authority does not state recommendation.

The outer walls of the industrial arts building should be non-bearing walls so as to allow for ease of expansion. The outer wall should not support all the weight of the roof. The interior and non-bearing walls should be of hollow tile, and the interior wall should have a wainscoating of hard-finished tile which is easy to clean. The interior wall above the wainscoating should be constructed of a soft wall-board material which is high in noise-absorption qualities.

Recommendations Concerning Design of Roofs for Industrial Arts Shops

The roof is also a matter of importance in planning an industrial arts shop. The recommendations concerning roof construction are presented in Table 16. The authorities recommend the flat type of roof, because it can be constructed more economically. They also approve of the saw-tooth type of roof as being desirable for obtaining natural daylight. The recommended types of roofs may be covered with pitch and slag, asphalt, or tile.

Recommendations Concerning Ceiling Construction for Industrial Arts Shops

Features pertaining to ceiling construction for industrial arts shops are presented in Table 17. The desirable ceiling height as recommended ranges from ten to fourteen feet. Soft wood or wallboard is recommended as the best material for the ceiling, because plaster ceilings do not render good acoustic quality.

TABLE 16

RECOMMENDATIONS CONCERNING THE DESIGN OF
ROOFS FOR INDUSTRIAL ARTS SHOPS

Desirable Features Concerning Roof Design for Industrial Arts Shops	Authorities Quoted				
	Mays and Casberg ⁷⁶	<u>Architectural Record</u> ⁷⁷	Stoneman, Broady and Brainard ⁷⁸	National Council on Schoolhouse Construction ⁷⁹	Strayer and Engelhardt ⁸⁰
	Agrees with Recommendations				
1. The flat roof may be constructed more economically.	Yes	Yes	Yes	*	Yes
2. The hip roof makes it possible to ventilate the industrial arts shop more easily.	*	*	*	*	*
3. The saw-tooth type of roof construction is desirable for obtaining natural light.	*	Yes	*	Yes	*
4. The type of roofs mentioned may be covered with pitch and slag, asphalt, or tile.	*	Yes	Yes	*	Yes
*Authority did not state opinion concerning this feature.					

⁷⁶Mays and Casberg, op. cit., pp. 8-32.

⁷⁷Arthur B. Mays, "The School Shop for General Education," Architectural Record, C (July, 1946), 94-100.

⁷⁸Stoneman, Broady, and Brainard, op. cit., pp. 190-191.

⁷⁹National Council on Schoolhouse Construction, op. cit., pp. 69-70.

⁸⁰Strayer and Engelhardt, op. cit., p. 15.

TABLE 17

RECOMMENDATIONS CONCERNING CEILING CONSTRUCTION
IN INDUSTRIAL ARTS SHOPS

Desirable Features Concerning Ceiling Construction in Industrial Arts Shops	Authorities Quoted				
	Mays and Casberg ⁸¹	<u>Architectural Record</u> ⁸²	<u>American School and University</u> ⁸³	National Council on Schoolhouse Construction ⁸⁴	Stoneman, Brogdy, and Brainard ⁸⁵
	Agrees with Recommendations				
1. The desirable ceiling height ranges from ten to fourteen feet.	Yes	Yes	Yes	Yes	Yes
2. A ceiling constructed of plaster does not render good acoustics.	*	Yes	*	*	Yes
3. Soft wood or wallboard is the best material for the ceiling.	*	Yes	*	*	Yes
4. The ceiling should absorb 35 per cent of the noise; from 50 to 75 per cent is preferable.	*	Yes	Yes	*	*
5. A ceiling with open beam is not good for lighting or ventilation.	*	Yes	*	*	*
*Authority did not state opinion concerning this feature.					

⁸¹Mays and Casberg, op. cit., p. 24.

⁸²Moehlman, op. cit., pp. 96-100.

⁸³American School and University, Twenty-First Yearbook, p. 220.

⁸⁴National Council on Schoolhouse Construction, op. cit., p. 71.

⁸⁵Stoneman, Brogdy, and Brainard, op. cit., pp. 276-278.

The ceiling of the industrial arts shop should be so constructed as to absorb at least 35 per cent of the noise; a ceiling constructed so as to absorb from 50 to 75 per cent of the noise is preferable. Ceilings with open beams are not considered good for lighting or for ventilation in industrial arts shops.

Recommendations Concerning the Windows in Industrial Arts Shops

Table 18 contains recommendations concerning the types of windows and the manner of installation of windows in industrial arts shops. These features affect both the lighting and the ventilation of the shop. The authorities agree that the windows should extend as near to the ceiling as is practical. The proportion of window area to floor area should be one square foot of glass per five square feet of floor area, or a ratio of one to five. Three of the authorities agree that the windows should be uniformly spaced, whereas two of the authorities did not give an opinion concerning this feature. Three of the authorities agree that the lower level of the window should be as high above work surfaces as possible, whereas two of the authorities did not make a statement regarding this feature of window placement. According to two of the authorities, the glass should be carefully chosen so as to diffuse the light rays; three of the authorities did not give an opinion concerning this feature.

TABLE 18
 RECOMMENDATIONS CONCERNING THE WINDOWS
 IN INDUSTRIAL ARTS SHOPS

Desirable Features Concerning Windows for Industrial Arts Shops	Authorities Quoted				
	Mays and Casberg ⁸⁶	Architectural Record ⁸⁷	American School and University ⁸⁸	National Council on Schoolhouse Construction ⁸⁹	Strayer and Engelhardt ⁹⁰
	Agrees with Recommendations				
1. The windows should extend as near the ceiling as is practical.	Yes	Yes	Yes	Yes	Yes
2. There should be one square foot of glass per five square feet of floor area.	Yes	Yes	Yes	Yes	Yes
3. The windows should be uniformly spaced.	Yes	*	*	Yes	Yes
4. The lower level of the window should be as high above work surfaces as possible.	Yes	Yes	*	*	Yes
5. The glass used should diffuse the light rays.	Yes	*	Yes	*	*
*Authority did not give opinion concerning this feature.					

⁸⁶Mays and Casberg, op. cit., pp. 22-24.

⁸⁷Mays, op. cit., pp. 94-100.

⁸⁸American School and University, Twenty-Second Yearbook, pp. 210-220.

⁸⁹National Council on Schoolhouse Construction, op. cit., pp. 81-83.

⁹⁰Strayer and Engelhardt, op. cit., pp. 42-43.

Recommendations Concerning the Exhaust System in Industrial Arts Shops

Recommendations concerning exhaust systems in industrial arts shops are presented in Table 19. The housing authorities recommend that exhaust flues should be installed to relieve industrial arts shops of heat, foul air, and dust. These authorities also recommend that exhaust air outlets should be installed in the finishing room, in the locker room, and in the washroom. Some of the special types of machines also need exhaust systems, and each wood cutting machine should have an exhaust system properly connected. The authorities also suggest that there should be an exhaust system in connection with the welding and foundry stations located in metal shops.

Recommendations Concerning the Types of Floors for Industrial Arts Shops

Table 20 presents the recommendations concerning the types of flooring materials which should be used in industrial arts shops. All of the authorities agree that the wood shops and drawing rooms should be floored with hard maple and that the floor in a metal shop should be of concrete. Two of the authorities agree that the office of the industrial arts shop should have a hard maple floor; three of the authorities did not give an opinion on this feature. The floors of the finishing and supply rooms should be concrete, and the floors of the locker and washroom should be concrete also.

TABLE 19

RECOMMENDATIONS CONCERNING THE EXHAUST
SYSTEMS IN INDUSTRIAL ARTS SHOPS

Desirable Features Concerning Exhaust Systems in Industrial Arts Shops	Authorities Quoted				
	Mays and Casberg ⁹¹	Wilber ⁹²	American School and University ⁹³	National Council on Schoolhouse Construction ⁹⁴	Strayer and Engelhardt ⁹⁵
	Agrees with Recommendation				
1. There should be exhaust flues to relieve industrial arts shops of heat and foul air.	Yes	*	Yes	*	Yes
2. Exhaust air outlets are needed in the finishing room.	Yes	Yes	Yes	*	Yes
3. Exhaust air outlets are needed in the locker and washrooms.	Yes	*	Yes	Yes	Yes
4. Each wood cutting machine should have a proper exhaust system connected.	Yes	Yes	Yes	*	Yes
5. There should be an exhaust system connected with the welding and foundry stations in the metal shop.	*	*	Yes	*	Yes

*Authorities do not give opinion.

⁹¹Mays and Casberg, op. cit., pp. 60-61.

⁹²Wilber, op. cit., pp. 290-292.

⁹³American School and University, Twenty-Second Yearbook, pp. 313-336.

⁹⁴National Council on Schoolhouse Construction, op. cit., pp. 154-155.

⁹⁵Strayer and Engelhardt, op. cit., pp. 26-36.

TABLE 20
 RECOMMENDATIONS CONCERNING THE FLOORS
 IN INDUSTRIAL ARTS SHOPS

Desirable Features Concerning Floors in Industrial Arts Shops	Authorities Quoted				
	Mays and Casberg ⁹⁶	<u>Architectural Record</u> ⁹⁷	<u>American School and University</u> ⁹⁸	National Council on Schoolhouse Construction ⁹⁹	Strayer and Engelhardt ¹⁰⁰
	Agrees with Recommendations				
1. The floor of the wood and drawing rooms should be of hard maple.	Yes	Yes	Yes	Yes	Yes
2. The floor of the metal shop should be concrete.	Yes	Yes	Yes	Yes	Yes
3. The office of the industrial arts shop should have a hard maple floor.	Yes	*	Yes	*	*
4. The floors of the finish and supply rooms should be concrete.	Yes	Yes	Yes	*	*
5. The floors of the locker and washrooms should be concrete.	Yes	Yes	Yes	Yes	Yes

*Authority did not state opinion.

⁹⁶Mays and Casberg, op. cit., pp. 8-33.

⁹⁷Mays, op. cit., pp. 94-100.

⁹⁸American School and University, Twenty-Second Yearbook, pp. 313-336.

⁹⁹National Council on Schoolhouse Construction, op. cit., pp. 71-100.

¹⁰⁰Strayer and Engelhardt, op. cit., pp. 40-61.

Summary

In Chapter II the standards and specifications pertaining to the various features of industrial arts housing believed to be desirable for any building designed to house an industrial arts program have been presented. Twenty tables were constructed and used to present the recommendations of seven authorities in the area of schoolhousing concerning the location of buildings, the building site, the amount of floor area per pupil, the proportion and size, the auxiliary rooms, illumination, wiring, heating, ventilation, locker and wash-room facilities, outside and inside exits, interior and exterior walls, roof design, ceiling, windows, exhaust systems, and flooring. The authorities were in agreement on the majority of the various features mentioned.

CHAPTER III

SCHOLASTIC POPULATION AND TRENDS IN SCHOLASTIC

POPULATION OF THE ARLINGTON HEIGHTS

SENIOR HIGH SCHOOL

The citizens of Fort Worth, Texas, have an enormous investment in their public school system. It is believed that the majority of the people of Fort Worth know little of the public schools, their actual operation, and their immediate problems. Fort Worth, Texas, is one of the most rapidly growing cities in the nation; there are indications that it will continue its phenomenal growth. The population has increased from 6,663 in 1880 to 281,097 in 1951, and the estimated population included in the 1950 school census indicates that the population will be 363,204 by 1956. The impact of this rapid growth in population on the Arlington Heights Senior High School is apparent, and in just a few years there will not be sufficient floor space in the present plant to house the estimated scholastic enrollment.

Some of the reasons for Fort Worth's rapid growth can be attributed to the construction of the Consolidated Vultee Aircraft Plant which was built during World War II and to other types of industry.¹ These industries are affecting

¹"Your Fort Worth Public Schools," Fort Worth Star Telegram, February 3, 1952, p. 2.

the population of Fort Worth and the number of children enrolled in the various schools of the Fort Worth Independent School District.

One of the purposes of this study is to present data concerning the enrollment in industrial arts at Arlington Heights High School and to analyze the data in order to ascertain whether or not there is a need for additional housing facilities for this phase of the curriculum. Table 21 presents the scholastic population of Arlington Heights Senior High School from 1940 through 1951.

TABLE 21

SCHOLASTIC POPULATION AND THE PER CENT OF THE
SCHOLASTIC POPULATION WHICH TOOK INDUSTRIAL
ARTS IN ARLINGTON HEIGHTS HIGH SCHOOL
FROM 1940 THROUGH 1951*

School Year	Scholastic Enrollment	Enrollment in Industrial Arts			Per Cent of Total Enrollment Which Took Industrial Arts
		Total	Wood and Metal	Drawing	
1940-41	874	123	93	30	14.5
1941-42	849	145	114	31	17.8
1942-43	724	119	99	20	16.4
1943-44	732	123	85	38	16.9
1944-45	745	148	108	40	19.7
1945-46	732	125	89	36	17.7
1946-47	710	127	94	33	17.8
1947-48	730	135	96	39	18.1
1948-49	738	109	52	57	14.7
1949-50	823	206	112	94	24.1
1950-51	799	223	119	104	27.9
1951-52	834	216	121	95	25.8

*Data secured from the Annual Report submitted by Arlington Heights High School Scholastic Population Report to the Southern Association of Colleges and High Schools, 1940 through 1951.

Table 21 also shows the enrollment in industrial arts for the years from 1940 through 1951 and gives the per cent of the student body which took industrial arts for each of the school years. Table 21 also shows that 19.2 per cent of the total scholastic population for the twelve-year span took one or more courses in industrial arts; during the last five years of this twelve-year span, 22.12 per cent of the total scholastic population took one or more courses in industrial arts.

The above data show that almost one-fourth of the entire scholastic population took one or more courses in industrial arts. Based upon an estimated enrollment of 1543 students in 1963,² and if in the future 19.2 per cent of the total number of students take courses in industrial arts, there will be approximately 297 students enrolled in industrial arts at Arlington Heights High School during the 1962-63 school year. Based on these figures, it is obvious that the present facilities for teaching industrial arts will not be adequate to care for this number of students.

Table 22 presents data concerning the estimated scholastic enrollment at Arlington Heights Senior High School, based on a recent study conducted by Elden Busby, Assistant Superintendent of Schools, and Roy Stone, Principal of Arlington Heights High School, Fort Worth, Texas.

²A survey conducted by Elden Busby, Assistant Superintendent of Schools, and Roy Stone, Principal of Arlington Heights Senior High School, Fort Worth, Texas.

TABLE 22

PRESENT AND ESTIMATED FUTURE SCHOLASTIC ENROLLMENT
AT THE ARLINGTON HEIGHTS HIGH SCHOOL AND THE
ESTIMATED ENROLLMENT IN INDUSTRIAL ARTS*

School Year	Estimated Scholastic Enrollment	Estimated Enrollment in Industrial Arts
1950-51	795	145
1951-52	733	140
1952-53	760	146
1953-54	879	169
1954-55	1021	196
1955-56	1143	219
1956-57	1240	238
1957-58	1322	254
1958-59	1225	235
1959-60	1350	259
1960-61	1338	257
1961-62	1485	285
1962-63	1433	275
1963-64	1543	297

*A survey conducted by Elden Busby, Assistant Superintendent of Schools, and Roy Stone, Principal of Arlington Heights Senior High School, Fort Worth, Texas.

The data in Table 22 show the estimated enrollment at Arlington Heights Senior High School by school years from 1950-51 through 1963-64. These data indicate an increase of almost 50 per cent in the scholastic enrollment and also show the estimated increase in industrial arts enrollment when based upon the percentage of the students who took industrial arts from the school years of 1940-41 through 1951-52.

Table 23 presents data concerning the total enrollment in industrial arts at Arlington Heights High School from the

school years of 1940-1941 through 1951-1952 and the number of students who took woodwork, drawing, and metal work each school year. The per cent of the total number of students who took industrial arts is also included in Table 23. Of the total number of students who took industrial arts, 67.3 per cent of the students took one or more courses in woodwork and metal work, and 32.7 per cent of the students took one or more courses in mechanical drawing.

TABLE 23

ENROLLMENT IN INDUSTRIAL ARTS AT ARLINGTON HEIGHTS
HIGH SCHOOL FROM 1940 THROUGH 1951 AND THE PER
CENT OF THE ENROLLMENT WHO TOOK WOOD AND
METAL AND THE PER CENT WHO TOOK DRAWING

Year	Enrollment in Industrial Arts	Number of Students Who Took Wood and Metal	Per Cent of Students Who Took Wood and Metal	Number of Students Who Took Drawing	Per Cent of Students Who Took Drawing
1940-41	123	93	75.6	30	24.4
1941-42	145	114	78.6	31	21.4
1942-43	119	99	83.2	20	16.8
1943-44	123	85	69.2	38	30.8
1944-45	148	108	72.9	40	27.1
1945-46	125	89	71.2	36	28.8
1946-47	127	94	74.1	33	25.9
1947-48	135	96	71.2	39	28.8
1948-49	109	52	47.7	57	52.3
1949-50	206	112	54.4	94	45.6
1950-51	223	119	53.3	104	46.7
1951-52	216	121	56.1	95	43.9

If approximately 67.3 per cent of the estimated 297 students who will take industrial arts during the 1963-64 school

year take woodwork, there will be approximately 200 students enrolled in woodwork. This is approximately seventy-nine students more than were enrolled in woodwork and metal work during the 1951-1952 school year. If approximately 32.7 per cent of the same estimated 297 students take mechanical drawing during the 1963-1964 school year, there will be approximately ninety-seven students enrolled in mechanical drawing. This estimated increase in enrollment of eighty-seven students cannot be housed and cared for in the present industrial arts shop with the present amount of tools and equipment.

The present policy at the Arlington Heights Senior High School with respect to the teaching loads of the teachers limits the number of periods per day per teacher to five. Based upon the estimated figures presented above, there will be enough students for eight classes of woodwork and metal work and five classes of mechanical drawing. If the present policy with respect to teaching loads continues in effect, the foregoing data indicate that three teachers will be needed to teach industrial arts at Arlington Heights Senior High School by the 1963-1964 school year.

CHAPTER IV

PRESENT AND PROPOSED PROGRAM IN INDUSTRIAL ARTS AT ARLINGTON HEIGHTS SENIOR HIGH SCHOOL

Industrial arts at the senior high school level is concerned primarily with industrial exploratory experiences and occupational information and is considered as a phase of the general education program. This phase of the total program should provide guided experiences in the field of industrial activities and should also provide means for concrete expression and opportunities for the discovery of individual creative abilities and aptitudes.

The industrial arts program should involve a continuous process of improvement in relation to the changing needs and interests of the pupils. The content of the curriculum should be planned and developed cooperatively by the staff, utilizing, whenever possible, contributions and suggestions from the pupils and school patrons and the material resources of the community and contributions of other educational agencies and institutions.¹

The industrial arts program in the Arlington Heights Senior High School, Fort Worth, Texas, should also provide opportunities for all of the pupils who wish to take courses in industrial arts. The necessary housing facilities,

¹Cooperative Study of Secondary School Standards, Evaluative Criteria, 1950 edition, p. 49.

equipment, and materials needed to care for an expanding scholastic enrollment in industrial arts should be provided if this phase of the curriculum is to function properly.

The data presented earlier in this investigation indicate certain changes which should be considered with respect to the present program, if the program is expected to care for the enrollment in industrial arts that is expected by the 1963-1964 school year. It appears to be advisable to separate woodwork from metal work. It also appears advisable to organize separate and distinct courses for each phase of the work and to provide a separate unit type of shop for each of these two phases of work. The present industrial arts curriculum at Arlington Heights Senior High School actually consists of Units III through VIII in woodwork, Units III through VI in metal work, and Units III through VIII in mechanical drawing. The units taught in each of the three divisions are affiliated and are assigned a value of one half credit for each unit.

Courses Currently Taught in Woodwork

The units of work which are affiliated and currently taught in woodwork consist of six units of work known as Woodwork III through Woodwork VIII. The purpose of Unit III in woodwork is to give the students a general understanding of the field of woodwork and its related activities through the systematic use of materials and tools and other related

subject matter. The pupils who select this course do so because of an interest in woodwork and a desire to acquire more knowledge concerning this phase of industrial arts. One major objective of this course is to care for the interests and needs of the pupils by giving them the richest experiences that the equipment, materials, and information will permit.

Unit IV in woodwork is a continuation of Unit III and involves more advanced projects and related information in woodwork. The student, because of his experience acquired in Woodwork III, is more able to direct himself and to find the information and use the materials which he needs in order to conduct his work. Generally, he also develops an increasing interest in additional work in woodwork which involves the use of the more complicated machines and tools.

Unit V in woodwork involves the study and use of power machinery as a labor-saving device. Consideration is given to all of the safety practices and their application to the operation of power woodworking machines and equipment. In this course no work is done by the students with hand tools when it can be done on a machine.

Unit VI in woodwork, as it is now taught, is a continuation of Unit V. The students who take this course have acquired some previous knowledge concerning the proper use of power machines, and more attention is given to the mechanics of the various machines and machine woodworking.

Unit VII in woodwork is restricted to those students who have successfully completed Units V and VI. In Unit VII each student is urged to develop skill and exhibit his ability in the particular phase of woodwork which he likes best. This may be machine work or strictly handwork with wood. Only those students who are definitely interested in continuing work in the area of woodwork are permitted to enroll in Unit VIII.

Courses Currently Taught in Metal Work

The units of work which are affiliated and currently taught in metal work are designated as Metal III, IV, V, and VI. Unit III is an orientation course into four of the basic phases of metal work. These phases include wrought iron, sheet metal, machine shop, and forging. In these units the students are taught to recognize the materials and the properties of the metals which are used in metal work; they are given opportunities to develop skill in working with the tools and equipment common to these phases of metal work.

Unit IV of metal work is a continuation of Unit III, and emphasis is placed upon the development of skill in performing the common metal work operations and the recognition of materials and their properties. Each student must complete designated projects in each of the phases of metal work mentioned in Unit III. The student also continues to work in the four basic phases of metal work taught in Unit V.

Gas welding and electric welding are introduced in Unit V, but are treated in an elementary manner. In Unit VI, greater freedom is given the student in his choice of projects. In this unit of metal work the student is still encouraged to explore in order to find his own individual abilities and aptitudes with respect to the metal industry.

Courses Currently Taught in Mechanical Drawing

The courses taught in mechanical drawing are referred to as Units III through VIII. Unit III in mechanical drawing is a course which is an introduction to drawing. In this unit of work the basic fundamentals and the correct procedure used in mechanical drawing are taught. This course includes work in the use of straight and curved lines, general graphic solutions, shape description, sketching, auxiliary construction, pictorial drawing, oblique projection, and angular perspective.

Unit IV in drawing is a continuation of Unit III, and consideration is given to individual interests with respect to the different phases of drawing and to related subject matter concerning skills, information, and objectives. In Unit V, the skills in drafting are emphasized, and exploratory experiences in several of the special drafting fields are provided.

Unit VI in drawing is designed to acquaint the students with the types of drawing which are included in the drawing

units VII and VIII. This is actually an exploratory course in that the students have nine weeks of work in machine drawing and nine weeks of work in architectural design in order to determine which of the two phases is more interesting to each student. In this course no attempt is made to teach details, but the course includes examples of typical work done in machine and architectural drafting.

Each of the Units VII and VIII in mechanical drawing actually consists of two separate areas of work in drafting. Unit VII includes machine drafting and design. The student is introduced to the machine drawing, which includes the transmission of power and motion, the mechanical operation of gears in the transmission of power, and detail drawings of bolts, nuts, gears, and pulleys. Unit VII also includes architectural designing to aid the student in developing a better sense and appreciation of proportion. Unit VIII is designed to give the student specific training in advanced detail and assembly drawing and is a continuation of the previous courses. It offers experiences to the students with respect to the best techniques in the field of machine design. The drawing course referred to as Unit VII is a prerequisite to Unit VIII.

Proposed Future Curriculum in Industrial Arts

Certain proposed changes in the present industrial arts program in the Arlington Heights Senior High School have

been discussed by the industrial arts instructors, the supervisor of industrial arts for the Fort Worth Public Schools, and other members of the present administration. Some of these proposed changes are as follows:

It has been proposed that Units III and IV in woodwork be changed so as to include from three to six weeks of properly guided hand tool operations and practices. The students who have had woodwork in junior high school would be given an introduction to the proper operation, care, and maintenance of the various woodworking machines used in industrial arts shops. One major objective of the course would be for each student to use each of the machines in the woodshop and to understand the basic operations, as well as the care and maintenance, of each of the machines.

As the course is now organized, Unit V in woodwork includes only wood-turning operations. It has been proposed that practice procedures and the proper use of the various wood-turning tools should continue to be taught in this course, but that the students should also do other work which would involve the use of other machines if time permits.

The proposed changes also stipulate that Unit VI in woodwork should be strictly a machine woodworking course and that the proper care and maintenance of the woodworking machines should be stressed and emphasized more in this unit than they have been in the past. It has been recommended that Units VII and VIII in woodwork should be reorganized so

as to offer specialized training in this phase of work.² These two courses may be reorganized so as to include specialized training in one type of work such as cabinet work, or they may contain several types of work.

There are other changes which have been proposed in the present industrial arts program in order for it to provide adequately for the anticipated increase in the industrial arts scholastic enrollment. It has been planned to separate the present courses in woodwork and metal work and to locate each in rooms designed for teaching woodwork and metal work courses. The woodshop should include all the necessary facilities considered desirable for good health and safety, and the equipment should be arranged so that safety practices may be observed and encouraged at all times.

The proposed changes in the courses in metal work are as follows: Unit III in metal work is to be reorganized so that it will be an introduction to general metal work. In this course as many of the basic operations in general metal work will be taught as time will allow. Unit IV in metal work will be a continuation of Unit III and will include as many machine operations as time will permit. The proper care, operation, and maintenance of the machines will be stressed in both of the foregoing courses.

²John E. Cherry, Supervisor of Industrial Arts, Fort Worth Public Schools, Fort Worth, Texas, personal interview, August 9, 1952.

It has also been proposed that Unit V in metal work should include oxyacetylene and electric welding and that the course should include information and experience in the proper operation and care of welding equipment. The projects selected should involve as many of the welding operations as possible. Unit VI in metal work will be a continuation of Units III, IV, and V, and more emphasis will be placed on the development of skills in selected fields of metal work according to this proposed program.

The housing facilities provided for the metal shop should contain the necessary facilities that will make it a safe and desirable place in which to work. The proper types of flooring should be installed which are suitable for the different phases of metal work taught in the shop. The welding stations, the foundry, and forging stations should be properly ventilated in order to remove all undesirable fumes and heat.

The proposed future plans will locate the drawing room in the same building with the wood and metal shops. The present courses in mechanical drawing consist of Units III through VIII, and the courses as now organized in A Tentative Course of Study³ have been found to be satisfactory. At the present time there are no plans to reorganize the present program with respect to the content and methods of

³Fort Worth Public Schools, A Tentative Course of Study for Senior High Schools, Curriculum Bulletin Number 211, 1939.

instruction in the area of mechanical drawing in the Arlington Heights Senior High School.⁴

This chapter has presented a brief description of the courses currently taught in the woodwork, metal work, and mechanical drawing classes in the Arlington Heights Senior High School. Each course in the three divisions, wood, metal, and drawing, has been explained separately as it is currently taught. Proposed future changes were presented which are believed will improve the industrial arts curriculum and provide for the students of Arlington Heights High School a much-improved industrial arts program.

⁴Ray M. Dyche, Instructor in Mechanical Drawing, Arlington Heights Senior High School, Fort Worth, Texas, personal interview, August 9, 1952.

CHAPTER V

FACILITIES NEEDED FOR THE INDUSTRIAL ARTS PROGRAM BASED UPON RECOMMENDED STANDARDS, FUTURE ENROLL- MENT, AND THE INDUSTRIAL ARTS PROGRAM

In planning housing facilities for the future industrial arts program at Arlington Heights High School, thought should be given to the needs of the future, as well as to present enrollment and needs. The industrial arts program should be planned so as to meet the educational needs in this particular community, and the housing facilities should be planned so that they will serve the program in terms of the future estimated enrollment in the wood, metal, and drawing classes of the industrial arts program.

The housing facilities needed for the industrial arts program at Arlington Heights High School, based upon the type of program, present and future estimated enrollment, and the standards and recommendations for industrial arts housing facilities by seven selected authorities in the field of schoolhousing, are presented as follows:

The industrial arts shop site.--All of the authorities agree that the site area related to industrial arts housing should be large enough to provide for future expansion. The building site for the industrial arts shop should have good

natural drainage; additional drainage facilities should be provided for the building site and surrounding grounds if needed.

The location of industrial arts shops.--The industrial arts shops should be housed in a separate building or in a wing of the main building and should be planned as an integral part of the total school plant. The shop should be located on the ground level or above, and not in the basement.

The proportion of the industrial arts shop.--A long, narrow shop and a square shop are considered undesirable. An industrial arts shop which is in the shape of the letter "L," "U" or any other shape which does not permit the instructor to observe the entire shop from any part of it is to be avoided. The proportion of the industrial arts shop should have a width to length ratio of from 1:1.5 to 1:2.

The size of the industrial arts shops.--Industrial arts shops will vary in size according to the activity or phase of work to be taught, but the following space allotments will be needed if the classes are taught on an hourly basis with an average of twenty-four pupils per class. Based upon a predicted enrollment of 297 students and a minimum of 50 square feet per pupil, three separate shops with at least 1485 square feet in each will be needed to provide adequately for the woodworking classes, the metal work classes, and the mechanical drawing classes at the Arlington Heights Senior High School.

Auxiliary rooms in industrial arts shops.--The number and kind of auxiliary rooms and areas needed depend upon the type of industrial arts program, but all industrial arts shops require auxiliary rooms and areas of one kind or another, and these should be planned as an integral part of the total shop. Each shop should have office space designed to meet its particular needs. The tool room for each shop should be planned so that the instructor can easily observe what the toolkeeper is doing without having to enter the tool room.

A dust-proof finishing room equipped with an independent exhaust system is needed for the wood and metal shops. Each of these shops should have its own supply and storage room. The location of the supply room should include a consideration of the ease of unloading from delivery trucks and the storing of supplies, as well as being convenient in issuing the supplies to the students. A library center, complete with the necessary tables, chairs, and shelving space to care properly for the needs of the students, should be included in each of the shops. Locker and washroom facilities should be provided for each of the shops, unless the over-all building plans provide these general facilities, located conveniently to the shop; these facilities, however, should be located in each shop, if possible.

The illumination of industrial arts shops.--The lighting system should be designed so as to provide an even distribution

of shadow-free and glare-free illumination over all of the shop. A minimum of twenty-five to thirty foot candles of light should be provided in the wood shop and metal shop, and fifty foot candles of light should be provided in the mechanical drawing rooms. The offices and tool rooms should have a minimum of twenty-five to thirty foot candles of light. The finishing room should have a minimum of fifty foot candles of shadow-free light, supplemented with natural light if possible. From five to ten foot candles of light should be provided for the supply and storage rooms, locker, and washrooms.

Electrical wiring in industrial arts shops.--The electrical wiring in each shop should be planned very carefully. All of the circuits should be controlled from one centrally located box. Emergency switches to the main line should be located at regular intervals around the shop. Service outlets for 110 and 220 volts should be located at nine to ten foot intervals around the walls, and these outlets should be thirty to forty inches above the floor level. Standard mercury switches should be installed in the finishing room and on all machines. Overhead outlet boxes should be installed to service small machines, and outlet boxes should be installed at designated points in the floor in order to service heavy machines.

Ventilation in industrial arts shops.--The ventilation system should be designed so as to maintain comfortable and healthful conditions at all times. From seven to thirty

cubic feet of air per minute per student should be displaced in the industrial arts shops and in all of the auxiliary rooms. Dust, smoke, fumes, vapors, and gases should be exhausted by mechanical means.

Heating systems in industrial arts shops.--The heating system should maintain automatically a temperature of 68 degrees Fahrenheit when measured sixty inches above the floor in the wood shop and the metal shop and 70 degrees Fahrenheit when measured thirty inches above the floor in the mechanical drawing room. The temperature in the offices should be 68 degrees Fahrenheit. The tool room, supply and storage room, and the locker and washrooms should be heated to 68 degrees Fahrenheit. The system should maintain a temperature in the finishing room ranging from 70 to 75 degrees Fahrenheit.

Locker and washrooms for the industrial arts shops.--Toilet facilities should be provided for the shops unless the over-all building plan provides toilet facilities which are easily accessible to the shops. If the new industrial arts shop is located in a separate building, and based upon twenty-four students per class, one water closet, one urinal, one wash basin, one shower, and one drinking fountain will be needed in each of the wood and metal shops and in the mechanical drawing room.

Corridors to and from the industrial arts shops.--The corridors should provide ample passageway leading to and from

the shop. The minimum width of the main corridor of any school building should be eight and one-half feet, and wider for larger schools. The minimum clear passageway of secondary corridors should vary with the length of such corridors and the number of doors leading into them.

Exits for industrial arts shops.--Not less than two exits should be provided for each shop. All doors used in connection with each exit should swing with the exit, and each exit should be at least thirty-six inches wide. The wood and metal shops should have one outside double exit to allow for the receiving and removal of large pieces of equipment and projects. Locks on the doors should require no keys for opening from the inside, and all exits should be lighted adequately.

The roof of the industrial arts shops.--The flat-type roof constructed of tar and gravel is economical and is long-wearing. The saw-tooth type roof is desirable if the building is to be of one-story construction, because this type of roof allows for ease of natural lighting.

The walls of the industrial arts shops.--The outside walls should be constructed so that future expansion will be possible. The present main building is constructed of brick, and brick should be used for the walls of the new structure because of the water-resistant qualities. The inside walls may be constructed of brick, tile, wood, or plaster on screen mesh. A wainscoting of glazed tile four feet high should be

used, and the walls above the tile should be constructed of some noise-absorbant material. The walls above the wainscoting may be constructed of wallboard or gypsum board. The inside walls should be non-bearing in order to allow for future expansion.

The ceiling of the industrial arts shops.--The ceiling should be constructed of material which has a high noise-reduction coefficient. Any type of fibrous or wallboard material that may be painted and repainted is recommended. The ceiling height should be twelve to fourteen feet.

The windows of the industrial arts shops.--The number of windows should be such that there will be one square foot of glass for every five square feet of shop floor space. Based on the estimated 4455 square feet of floor space in the three shops, there should be at least 891 square feet of window glass in order to provide adequate natural light for the shops. The windows should be uniformly spaced, and the lower level of the windows should be as high above the tops of workbenches and work surfaces as is permissible. There is a tendency, however, to depart from this practice and to place the lower level of the windows nearer the floor level. This aspect of the building possibly should be investigated further. The factory type of steel frame is more desirable for shops than the conventional residence or office building type of frame.

Exhaust systems in the industrial arts shops.--A

mechanical exhaust system, centrally located, that will remove dirt and sawdust from the machines of the wood shop, should be provided. Grinders and welding stations located in the metal shop should also be attached to the central exhaust system. The finishing room, locker rooms, and wash-rooms should also be equipped for exhausting dust, odors, fumes, vapors, and gases.

Flooring in the industrial arts shops.--The floors of the shops should have a wearing surface designed to endure, but they should not be so non-resilient as to be detrimental to health. The floors in each shop should be insulated to reduce noise so as not to interfere with each other and with other classrooms. The flooring materials will need to be different in the wood and metal shops in order to serve better each particular shop. The wood shop and the mechanical drawing room should have maple flooring; the metal shop should have a combination of maple and cement flooring. Cement should cover the welding, foundry, and forging areas in the metal shop.

Chapter V has presented recommended standards and housing facilities recommended for the Arlington Heights Senior High School based upon recommendations of seven selected authorities in the field of schoolhousing. The recommendations presented pertain to the shop site, location, proportion, and size. Suggestions and information concerning auxiliary rooms, illumination, electric wiring, ventilation,

heating, locker and washrooms, corridors, exits, walls, flooring, ceilings, windows, roof design, and exhaust systems were also presented.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This study was concerned with the design, construction, and specifications of the housing facilities for industrial arts programs and a study of the needs of the Arlington Heights Senior High School, Fort Worth, Texas, with respect to providing adequate housing facilities for the industrial arts program in this particular school.

Chapter I introduces the study, states the problem, and presents reasons why the study should be made. The purpose, limitations, definition of terms, sources of data, organization of the study, and related studies are also presented.

Chapter II contains a treatment of the current standards and recommendations concerning housing facilities for industrial arts programs. The various standards concerning housing facilities for industrial arts programs are presented in tabular form.

Chapter III presents data concerning the past scholastic enrollment at the Arlington Heights Senior High School for twelve years and gives the anticipated scholastic enrollment to the 1963-1964 school year. Data concerning the scholastic population are presented in three tables.

Chapter IV presents a description of the present industrial arts program. An explanation of the three phases of industrial arts which are taught, namely wood, metal, and drawing, are presented in order to aid the reader in understanding what is taught in each of the various units in woodwork, metal work, and mechanical drawing. This chapter also contains a description of the proposed future industrial arts program, based upon the anticipated enrollment and the present plans of the industrial arts supervisor and other administrative officers.

Chapter V presents a treatment of the facilities believed to be needed to house the industrial arts program at Arlington Heights High School, based upon the recommendations of the seven authorities in the area of schoolhousing, the future expected enrollment, and the proposed program in industrial arts.

Chapter VI contains a summary of the study, conclusions based upon the results of the study, and certain specific recommendations.

Conclusion

Based upon the recommended standards and specifications for industrial arts housing as given by the seven authorities selected for this study and based upon the present program and the proposed future program and data concerning the expected future enrollment in industrial arts at Arlington

Heights Senior High School, the following conclusions have been drawn:

1. From the information presented in this study it is concluded that the present housing facilities for industrial arts at Arlington Heights Senior High School, Fort Worth, Texas, meet the recommended standards for industrial arts housing, as established by authorities in the field, only in part.

2. Based upon an estimated enrollment of 1543 students at Arlington Heights High School during the school year of 1963-1964, it is probable that 297 students will be enrolled in industrial arts courses, if 19.2 per cent of the total 1963-1964 estimated enrollment continue to take one or more courses in industrial arts. If, however, 22.12 per cent of the estimated enrollment, which was the per cent of the total enrollment which took one or more courses in industrial arts during the school years from 1947-1948 through 1951-1952, continue to take industrial arts, there will be a total of 341 students enrolled in industrial arts.

3. Based upon these same estimated figures, there will be at least eight classes of woodwork, eight classes of metal work, and five classes of mechanical drawing taught during the 1963-1964 school year.

4. If possible, the industrial arts woodwork shop and metal work shop should be housed in separate rooms designed for each of these particular phases of industrial arts.

5. The mechanical drawing room should be housed in the same building with the wood shop and the metal shop.

6. Based upon a predicted enrollment of 297 students in industrial arts and a minimum of fifty square feet per pupil, 4455 square feet of floor area will be needed to provide adequately for the woodworking classes, the metal work classes, and the mechanical drawing classes at the Arlington Heights Senior High School by 1963. If the predicted enrollment when based upon the last five school years (1947-1948 through 1951-1952) is 341 students and a minimum of fifty square feet of floor space per pupil is provided, 5115 square feet of floor space will be needed.

Recommendations

The recommendations based upon the findings of this study are as follows:

1. The housing facilities for the industrial arts program should be located away from the main building or in a separate wing of the main building.

2. The industrial arts shops should be housed at ground level.

3. There should be a minimum of fifty square feet of floor area per student provided in each of the three shops.

4. A shop which is rectangular in shape with a proportion of 1:1.5 to 2 is recommended.

5. All necessary auxiliary rooms should be provided,

and the size of each should be in proportion to the number of square feet of floor area allotted each student.

6. The wood shop and metal shop should have a light illumination reading ranging from twenty-five to thirty foot candle power, and the drawing room should have a minimum of fifty foot candle power.

7. The light reading in the office and tool room should be not less than fifteen nor more than thirty foot candle power. The lighting in the finishing room may range from twenty-five to sixty candle power. The lumber room and metal storage room, as well as the locker and washroom, should have a light reading of at least ten foot candle power.

8. The electrical outlets in the wood and metal shops should be located at intervals ranging from nine to ten feet around shop walls, and these should be from thirty to forty inches above the floor level. Safety mercury switches should be installed on all machines and in the finishing room.

9. The ventilation system should provide a change of air of not less than seven nor more than twenty-five cubic feet per minute per student in the wood shop, metal shop, the mechanical drawing, and the auxiliary rooms.

10. The heating facilities installed should maintain a temperature ranging from 60 to 70 degrees Fahrenheit in all of the shops and auxiliary rooms, except in the finishing room and locker and washroom, where the temperature should be 78 degrees Fahrenheit.

11. Locker and washroom facilities should be provided with a ratio of one closet, one urinal, one wash basin, one shower, and one drinking fountain for each twenty-four students.

12. There should be two exits to each shop, and one of the exits should be at least eight feet or more in width.

13. The outer walls should be of brick, and they should be furred and waterproofed. The outer walls should be constructed so that future expansion will be possible. The interior walls should be non-bearing in order to allow for future expansion. The inner walls should have a wainscoting of finished tile to allow for ease of cleaning. The wall above the wainscoting should be of some material high in noise-absorption qualities.

14. The flat type of roof is recommended.

15. The ceiling height should be not less than ten nor more than fourteen feet. The ceiling material should be high in noise-absorption quality.

16. The windows should be designed so that there will be at least one square foot of glass for every five square feet of floor area.

17. There should be an exhaust system provided for each shop.

18. The flooring for the wood shop and the mechanical drawing room should be of maple wood. The floor for the metal shop should be of cement and maple.

19. Not less than 4455 square feet, and if possible 5115 square feet, of floor space should be provided to house industrial arts at Arlington Heights Senior High School by the 1963-1964 school year.

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