THE STORAGE OF LARGE WOODWORKING PROJECTS DURING THE ASSEMBLY AND FINISHING STAGES

by

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CHAPTER I

INTRODUCTION

Having been confronted with the problem of the storage of large projects in a high school woodshop, the author feels that an investigation of the storage methods used in other schools will be of considerable value. Preliminary study and discussion with other instructors has indicated the storage of the large project is a universal problem and one that, generally, remains unsolved.

The difficulty seems partially due to the lack either of sufficient space or of any provision in the budget for the construction of the necessary shelving or cabinets — or both. These deficiencies indicate the failure of school architects and administrators to understand the storage requirements of a woodworking laboratory.

In this regard, Willis A. Whitehead, Member of the Summer Session Staff, Ohio State University, states (14, p.508) "In traveling about the country visiting schools, one frequently finds an apparent lack of planning with reference to the purpose of the building. This situation seems more acute when considering the elements of the structure than when dealing with it as a whole."

In an article which appeared in American School and University, Elroy W. Bollinger (1, p.211) makes the following comments:

> Designing plant facilities for the industrial arts area of a school program is no one-man job. We usually

> say, 'the Architect designed the building'— But did he? No, not alone, because a building is constructed to meet some particular need. A school building is not built for the Architect, not even for the administration, alone. If it is to be functional, it must be designed around the needs of those who use it.
>
> . . .
>
> The Teacher Knows
>
> Architects are not school administrators and school administrators, for the most part are not or never have been shop teachers. But our problem is that of designing facilities for the use of the industrial arts teacher. It seems logical that he should know better than anyone else what is needed to make his program effective ..... what service facilities his instruction requires.

Bollinger (1, p.213) concludes with a list of some things to avoid in shop planning. Among these is: "Insufficient storage space provided for raw materials; for students' work and equipment; for projects completed or in process of completion."

Statement of the Problem

Thus the problem shows itself to require a two-fold investigation:

1. How the problem is handled in the various shops.
2. What do the instructors believe would be the ideal storage facilities for the large project in a woodshop of the secondary school level?

It is hoped the results of this investigation may be used to show the need for project storage and to make recommendations of a definite nature to administrators and others responsible for shop planning.

Terminology

The term "large woodworking project" for the purpose of this study, includes all projects which, after assembly, are too large for the individual student locker and which therefore must be stored elsewhere until completed and taken home.

The terms "woodshop", "woodworking laboratory", or "industrial arts woodshop" are used interchangeably in this study, and refer to the industrial arts shop in which the major effort is an instructional program in woodworking.

Procedure and Source of Data

The data were obtained in the following way:

1. A review was made of available literature dealing with the subject of project storage.
2. A two-part questionnaire check-list was drawn up. Part one covered the available storage facilities currently used, while part two was designed to find or establish criteria for ideal storage compartments.
3. High schools and junior high schools of Western Oregon employing at least one industrial arts instructor each, for a minimum of four periods each day, were selected by reference to the Oregon School Directory.
4. Each visitation was made at school (46 high schools and 8 junior high schools). The woodshop instructor was personally interviewed, at which time the check list was filled out.

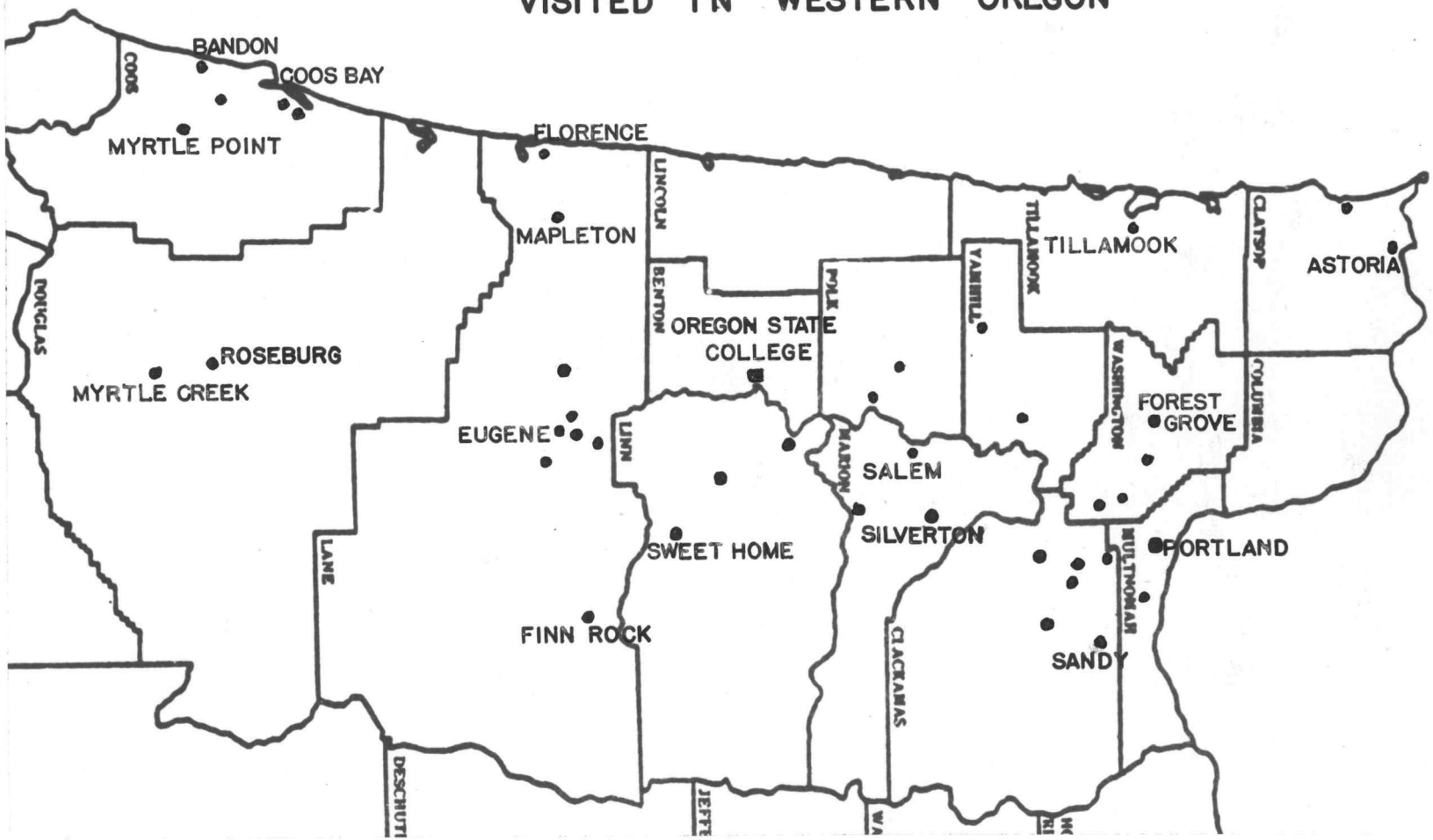
Limitations

The limitations of the study are as follows:

1. As this was an interview study, the distances involved necessitated limiting the schools visited. Time and travel were necessarily to be considered. This fact has automatically limited the number of experiences and the number of opinions upon which the recommendations are based.

2. The assumption was made that individual student lockers, or some satisfactory substitute, was available for the storage of projects prior to assembly. The recommended storage areas and cabinets are therefore in addition to these lockers.

GEOGRAPHICAL LOCATION OF SCHOOLS VISITED IN WESTERN OREGON



CHAPTER II

REVIEW OF LITERATURE

A review of professional literature reveals remarkably little reference to the problem--except a general acknowledgment of the need for a solution. There are practically no concrete recommendations for the planning of storage areas suitable for partially completed projects, and no recognized criteria for such planning. The statements made are usually generalizations, more or less lost in a discussion of the broader topic of shop planning as a whole.

An editorial in the Architectural Record (10, p.96) entitled, "Planning the Industrial Arts Shop" contains this statement under the heading, "General Room Considerations":

> Storage of work in progress. This is the provision which is most generally neglected or forgotten altogether. Locker space is required for this in every department. One suggestion is the use of space under work benches.

Whitehead (14, p.514) says,

> Racks and shelving should be provided for the orderly storage of all materials, including lumber, sheet metal, steel, paper, hardware, etc. Project storage, on the other hand, may be provided elsewhere to care for partially completed and finished pieces. Such storage space should be designed to protect the pieces stored.

John C. Marshal[1] (8, p.209), includes under "Do's and Don'ts of School Shop Planning", this item on storage spaces:

> Don't just provide storage space. . . . . .Do provide planned storage units designed to accomodate the types

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1 Supervisor of Surveys and Schoolhouse Planning, West Virginia State Department of Education.

> and quantities of things that are stored--books, maps, paper, toys, records, clothing, exhibits, food, globes, models, lumber, games, unfinished pupil projects, athletic equipment, etc.

Warner (11, p.36) remarks:

> The use of mezzanines or balconies in shops has proved quite satisfactory in Oklahoma and Texas, where men like Badger and Rousch have employed them. The plan is to suspend a balcony from a 13-foot or higher ceiling to within 6 feet 6 inches of the floor and to place lockers for general storage under the balcony and provide space on the balcony for the storage of lumber or metal and projects in the process of completion.

Hippaka[2] (5, p.94) writes, "Ample storage space for supplies, tools, books, and student work is essential."

G. O. Voss, Minnesota Supervisor of Trade and Industrial Education, (7, p.27) makes the following recommendation concerning small shops:

> Recommendation: Three rooms, consisting of a shop (two ordinary classrooms in size); a drawing room; and a room for project storage, finishing, and supply storage should be provided. To afford opportunities for general industrial training in a small school where the number of boys enrolled in each of the years, seven, eight, and nine will not exceed sixteen, a one-room department may be approved. Separate project storage and finishing facilities, however, should be provided.

Gottshall (3, p.340), an instructor in a Pennsylvania high school, writes on planning the industrial arts shop as follows:

> Many shops lack even the bare essentials necessary to make good shop-keeping possible. Sufficient storage space is seldom provided by the architect unless the shop teacher is consulted when plans are drawn. The

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2 Professor of Industrial Education at Iowa State College.

> efficiency of shops is greatly impaired by lack of storage space and storage facilities, such as supply rooms, lumber racks, cupboards, and cabinets in which to house supplies and partly completed projects. These should be in the shop or directly adjacent to it and accessible through a door from the shop, instead of having them located in some far off corner of the building..... Project material belonging to one class or section must be locked up to make it inaccessible to other groups, in order to prevent damage or loss.

A few authors are a little more detailed in their recommendations. For example, Weaver (13, p.238), an instructor in an Indianapolis high school, claims:

> The problem of planning a shop then is not a matter of just sitting down and drawing a floor plan and saying: "This is the ideal shop floor plan." The following list is therefore submitted to help those confronted with the task of planning new school shops.
> .....
>
> Step 6. Proper location of auxiliary rooms such as office, tool crib, project rooms, gluing and finishing room, lumber storage rooms, supply or stockroom, dark room, and the like must also be considered and studied.

Quoting again from Weaver (13, p.239):

> Auxiliary Rooms
>
> Project-Storage Room
>
> 99. Are separate project storage rooms provided for each class using a given shop? Adequate floor space is 7 by 7 ft. with a 13 ft. ceiling.
>
> 100. Can each be locked:
>
> 101. Are detailed drawings of built-in shelves to be used available?
>
> 102. Has a 31 in. clear space above the floor been provided beneath the shelves in each project room for storage of partly assembled projects?

103. Has a rolling or sliding ladder been installed to store material on higher shelves?

104. Are project room doors of adequate size? The standard is 3 by 7 feet.

Leaf (7, p.99) states:

> For storing unfinished projects, the following is recommended: Shelves in the finishing room, a separate room with shelves and cases, or large lockers with grilled panel doors.

Groneman[3] (4, pp.92-92), discusses storage in the description of a plan for a new shop, stating:

> It seems an impossibility to have adequate storage for the shop or laboratory. Even after careful planning there is a tendency to reduce storage space to make room for more work stations. Project storage has been accounted for in this school plan by having a separate compartment for each of the four classes which meet in the shop. This is not always satisfactory for all projects, but it will accommodate at least 90 per cent of them. Each area may be locked by the instructor at the conclusion of the period which prevents the possible disappearance of partially completed project materials.
>
> The entire series of project and material storage compartments has 340 sq. ft. of floor space with a seven foot ceiling, over which may be found the small finishing room and lumber storage section.

Johnson (6, p.89) describes project storage in a Wisconsin high school woodshop, in the following manner:

> Project storage racks will be installed on steel posts in the center of the shop and will be high enough so the students can work under them. Benches with storage facilities in them are contemplated.

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3 Professor of Industrial Education, School of Engineering, The Agricultural and Mechanical College of Texas.

In a recent article, Wason (12, p.135) explains the method used to increase storage space in the shop at one of the Connecticut high schools:

> An answer to this problem was found by utilizing under-bench space. The woodworking benches, of metal construction, were fitted with platforms of 3/4 in. lumber across the stretchers. Simple frames were fitted into the end openings and into one side.
>
> The remaining side was fitted with a hinged door which, with the frames, was covered with 1/2 in. mesh hardware cloth stapled securely in place. Miter-jointed molding on the edges of the cloth gives a neat appearance. Painted and padlocked these lockers provide attractive and adequate safe storage.

Schweickhard[4] (9, p.183) recommends the construction of a number of shelves of varying heights and widths for industrial arts shops. "These allow for the storage of heavy and light articles of various sizes." A drawing of these suggested shelves appears in the appendix.

A study of the above material still leaves one without any suggestion as to the number of projects to be stored from a given size of class, or the probable percentage of different sizes of projects that occur in a typical industrial arts woodshop program. An attempt is made in this study to meet the need for information of this type.

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4 Assistant Superintendent of Schools, Minneapolis, Minnesota.

CHAPTER III

THE STUDY--FOUNDED UPON PERSONAL INTERVIEWS

The data presented in this study were obtained from personal interviews with the industrial arts woodshop instructors of forty-six high schools and eight junior high schools located in Western Oregon. A review of literature dealing with the industrial arts program and facilities indicates that the woodworking programs and the storage problems found in these Oregon shops are relatively typical for the country as a whole.

Data gathered from the junior high schools were treated separately. It was soon apparent to the interviewer that the program offered on the junior high school level was frequently such as to make the problem of storage far less critical than at the high school level, whether in the 4-year school or the 3-year senior high. In the junior high school the projects constructed were mostly of such a nature and size that they could be stored in the individual student locker.

A copy of the questionnaire check list can be found in Appendix A. A tabular report of the data follows:

Part I. Questionnaire Responses

Question	High School		Junior High	
	Cases	Percent	Cases	Percent
1. Type of woodworking program:				
General Woodworking	44	95.6	8	100
Cabinet	2	4.3	0	0
Carpentry	12	26.1	0	0

The general type program is considered to include cabinet and bench and machine woodworking, but not carpentry. One high school limited the work to cabinet construction and one to a cabinet and carpentry (minimalic building) program. Eleven high schools had both a general woodworking and a carpentry program.

Question	High School		Junior High	
	Number	Average	Number	Average
2. How many classes (woodworking)? Total enrollment?				
Classes	2-7	4.9	2-6	5.1
Enrollment	30-177	99.3	26-150	99.6
	Cases	Percent	Cases	Percent
3. In these classes is there a problem with the storage of projects too large for pupil lockers, during assembly and finishing stages?				
Yes	41	89.1	5	62.5
No	5	10.9	3	37.5
	Number	Average	Number	Average
4. Approximately how many such projects are likely to be on hand at one time?	4-90	26.5	6-75	29.1
	Cases	Percent	Cases	Percent
5. Are there facilities for storing such projects?				
Yes	34	73.9	6	75
No	12	26.1	2	25

Question	High School		Junior High	
	Cases	Percent	Cases	Percent
6. What are these facilities?				
Open Shelf	24	52.2	5	62.5
Large Compartment (Cabinet)	3	6.5	1	12.5
Storage Room	12	26.1	1	12.5
Balcony	6	13.0	0	0
Other (Floor space, over head racks, etc.)	18	39.1	1	12.5
	Square Feet		Square Feet	
7. How many square feet of space is available for this purpose?				
Shelves	0 - 300		0 - 360	
Cabinets	0 - 200		0	
Floor Space	0 - 2000		0 - 600	
Other	0		0	
	Cases	Percent	Cases	Percent
8. Do the facilities allow safeguarding the projects?				
As a whole?	12	26.1	2	25
By class groups?	3	6.5	0	
Individually?	1	2.2	1	12.5
Not at all?	31	67.4	6	75

Inasmuch as some shops use a combination of storage facilities, the percentages of the above and of the following question will total more than 100 percent.

	Cases	Percent	Cases	Percent
9. Where is the space located?				
Main shop (incl. balcony)	26	56.5	4	50
Finishing Room	22	47.8	3	37.5
Storage Room	9	19.6	0	
Lumber Room	4	8.7	1	12.5
Class Room	4	8.7	0	

Question	High School		Junior High	
	Cases	Percent	Cases	Percent
10. Do you find the space adequate?				
Yes	12	26.1	3	37.5
No	34	73.9	5	62.5

Two of the twelve affirmative answers from the high schools were qualified by the statement "adequate but not satisfactory due to location or arrangement."

	Cases	Percent	Cases	Percent
11. If no space is provided for this purpose, do you find it difficult to prevent damage to the larger projects?				
Yes	32	69.6	4	50
Slight	6	13.0	2	25
No	7	15.2	2	25

One high school instructor had had no opportunity to ascertain the extent of his storage problem as the school was new and no projects had reached the assembly stage. However, he believes the storage space is definitely inadequate.

Part II. Questionnaire Responses--Criteria

This portion of the questionnaire was presented with the following preliminary statement: Assume that you have been asked to plan a new shop in a projected school. In this shop plan you are to include recommendations for whatever storage facilities you believe are needed to house project materials in all stages of completion.

You have been assured that the budget is ample to meet any reasonable request so that the shop storage problem, not the one of budget limitation, is to be met.

Question	High School		Junior High	
	Cases	Percent	Cases	Percent
1. Should the storage be by individual compartments?				
Yes	44	95.6	7	87.5
No	2	4.4	1	12.5
"Individual" in this case applies to projects, not students.				
	Cases	Percent	Cases	Percent
2. Should the storage be by group compartments (for each class?)				
Yes	2	4.4	1	12.5
No	44	95.6	6	75.0
No opinion	0		1	12.5
3. Should the compartments be made of				
Wood?	34	73.9	6	75
Metal?	3	6.5	0	
Combination?	8	17.4	1	12.5
No opinion	0		1	12.5
4. Should the compartments have doors?				
Yes	39	84.8	6	75.0
No	7	15.2	1	12.5
No opinion	0		1	12.5
A. Each compartment separately?				
Yes	8	20.5	0	
No	31	79.5	0	

Question	High School		Junior High	
	Cases	Percent	Cases	Percent
B. Group of compartments for class?				
Yes	30	76.9	6	100.0
No	9	23.1	0	

One high school instructor suggested some compartments enclosed each way; some individual compartments be in the finishing room, and class-group compartments in the combination lumber-and-storage room.

	Cases	Percent	Cases	Percent
5. If doors are used should they be				
solid?	25	54.4	4	50.0
frame with wire mesh?	19	41.3	3	37.5
No opinion	2	4.3	1	12.5
6. Should the doors be				
sliding?	20	43.5	3	37.5
hinged?	25	54.3	4	50.0
No opinion	1	2.2	1	12.5
7. If they are hinged where should the hinge be located?				
A. Individual compartments.				
Top	14	30.4	2	25.0
Side	21	45.7	2	25.0
Bottom	6	13.0	1	12.5
No opinion	5	10.9	3	37.5
B. Group or class compartments.				
Top	1	2.2	0	
Side	43	93.5	6	75.0
Bottom	0		1	12.5
No opinion	2	4.3	1	12.5

Question	High School		Junior High	
	Cases	Percent	Cases	Percent
8. Should individual compartments have				
single doors?	34	73.9	6	75.0
double doors?	5	10.9	0	
No opinion.	7	15.2	2	25.0
9. Should group or class compartments have				
single doors?	4	8.7	0	
double doors?	38	82.6	7	87.5
No opinion.	4	8.7	1	12.5
10. Should the doors have locks?				
Yes	38	82.6	6	75.0
No	7	15.2	1	12.5
No opinion	1	2.2	1	12.5
11. Should the compartments all be the same size?				
Yes	6	13.0	2	25.0
No	40	87.0	4	50.0
No opinion	0		2	25.0
12. What size or sizes would you recommend?				
One size	5	10.9	2	25.0
Two sizes	15	32.6	1	12.5
Three sizes	23	50.0	3	31.5
Four sizes	1	2.2	0	
No opinion	2	4.3	2	25.0

Frequency Table of Recommended Sizes

Table I

Recommended Height of First or Large Compartment

Frequency	Percent	Height
	A. High School	
1	2.3	7 ft.
1	2.3	6 ft.
2	4.5	5 ft.
1	2.3	4 ft.
1	2.3	3 ft. 4 in.
18	40.9	3 ft.
1	2.3	2 ft. 10 in.
2	4.5	2 ft. 8 in.
5	11.4	2 ft. 6 in.
11	25.0	2 ft.
44		
	B. Junior High	
1	16.6	4 ft.
3	50.0	3 ft.
1	16.6	2 ft. 6 in.
1	16.6	2 ft.
6		

Read one or 2.3% recommended a height of 7 ft.

Table II

Recommended Width of First or Large Compartment

Frequency	Percent	Width
	A. High School	
10	22.7	5 ft.
25	56.8	4 ft.
1	2.3	3 ft. 4 in.
5	11.4	3 ft.
1	2.3	2 ft. 6 in.
1	2.3	1 ft. 6 in.
1	2.3	1 ft. 4 in.
44		
	B. Junior High	
2	33.3	4 ft.
1	16.6	3 ft. 6 in.
2	33.3	3 ft.
1	16.6	2 ft. 6 in.
6		

Table III

Recommended Depth of First or Large Compartment

Frequency	Percent	Depth
	A. High School	
3	6.8	5 ft.
2	4.5	4 ft.
9	20.5	3 ft.
12	27.3	2 ft. 6 in.
17	38.6	2 ft.
1	2.3	1 ft. 6 in.
44		
	B. Junior High	
1	16.6	3 ft.
1	16.6	2 ft. 6 in.
4	66.7	2 ft.
6		

Table IV

Recommended Height of Second or Medium Compartment

Frequency	Percent	Height
	A. High School	
1	2.6	4 ft.
4	10.3	3 ft.
1	2.6	2 ft. 6 in.
26	66.6	2 ft.
3	7.7	1 ft. 8 in.
3	7.7	1 ft. 6 in.
1	2.6	1 ft. 4 in.
39		
	B. Junior High	
1	25.0	2 ft. 6 in.
2	50.0	2 ft.
1	25.0	1 ft. 8 in.
4		

Table V

Recommended Width of Second or Medium Compartment

Frequency	Percent	Width
	A. High School	
2	5.1	4 ft.
25	64.1	3 ft.
7	17.9	2 ft.
1	2.6	1 ft. 8 in.
4	10.3	1 ft. 6 in.
39		
	B. Junior High	
4	100.0	2 ft.

Table VI

Recommended Depth of Second or Medium Compartment

Frequency	Percent	Depth
	A. High School	
3	7.7	4 ft.
5	12.8	3 ft.
12	30.8	2 ft. 6 in.
18	45.8	2 ft.
1	2.6	1 ft.
39		
	B. Junior High	
1	25.0	3 ft.
3	75.0	2 ft.
4		

Table VII

Recommended Height of Third or Small Compartment

Frequency	Percent	Height
	A. High School	
2	8.3	3 ft.
2	8.3	2 ft. 6 in.
1	4.2	2 ft. 2 in.
11	45.8	2 ft.
6	25.0	1 ft. 6 in.
2	8.3	1 ft. 4 in.
24		
	B. Junior High	
1	33.3	1 ft. 10 in.
1	33.3	1 ft. 6 in.
1	33.3	1 ft. 4 in.
3		

Table VIII

Recommended Width of Third or Small Compartment

Frequency	Percent	Width
	A. High School	
2	8.3	4 ft.
2	8.3	3 ft.
3	12.5	2 ft. 6 in.
10	41.7	2 ft.
6	25.0	1 ft. 6 in.
1	4.2	1 ft. 2 in.
24		
	B. Junior High	
1	33.3	3 ft.
1	33.3	1 ft. 6 in.
1	33.3	1 ft. 4 in.
3		

Table IX

Recommended Depth of Third of Small Compartment

Frequency	Percent	Depth
	A. High School	
1	4.2	5 ft.
1	4.2	4 ft.
1	4.2	3 ft.
7	29.1	2 ft. 6 in.
13	54.2	2 ft.
1	4.2	1 ft. 8 in.
24		
	B. Junior High	
3	100.0	2 ft.

One high school instructor recommended a fourth size, as follows:

Height	1 ft. 8 in.
Width	1 ft. 8 in.
Depth	2 ft. 6 in.

Another high school instructor recommended separate storage rooms or enclosures, with floor space six feet by eight feet. These rooms were to have shelving spaced at varying distances to hold projects of different size. A junior high school teacher suggested a series of shelves, 16 ft. in length and 30 in. in depth, with the first shelf 6 in. from the floor, the second shelf 2 ft. above the first, and the third shelf 16 in. above the second. The larger spaces were planned for the projects from the second year class, while the smaller spaces were to be reserved for the use of beginners.

13. Percentage of each size recommended:

Frequency Table of Percentages Recommended

Table X

Percentage of Compartments to be the Large Size

Frequency	Percent	Percentage to be Large
	A. High School	
5	11.4	100.0
3	6.8	50.0
1	2.3	40.0
1	2.3	33.0
5	11.4	30.0
9	20.5	25.0
13	29.5	20.0
2	4.5	15.0
4	9.1	10.0
1	2.3	5.0
44		
	B. Junior High	
2	33.3	100.0
2	33.3	25.0
2	33.3	20.0
6		

Read 5 or 11.4% recommended 100% to be large compartments.

Table XI

Percentage of Compartments to be the Medium Size

Frequency	Percent	Percentage to be Medium
	A. High School	
1	2.6	90.0
1	2.6	80.0
6	15.4	75.0
3	7.7	70.0
1	2.6	67.0
1	2.6	60.0
3	7.7	50.0
1	2.6	45.0
4	10.3	40.0
2	5.1	35.0
10	25.6	30.0
3	7.7	25.0
3	7.7	20.0
39		
	B. Junior High	
1	25.0	75.0
2	50.0	50.0
1	25.0	35.0
4		

Table XII

Percentage of Compartments to be the Small Size

	A. High School	
6	25.0	60.0
7	29.0	50.0
2	8.3	45.0
5	20.8	40.0
1	4.2	35.0
1	4.2	30.0
1	4.2	25.0
1	4.2	20.0
24		
	B. Junior High	
1	33.3	40.0
2	66.6	30.0

Question	High School		Junior High	
	Cases	Percent	Cases	Percent
14. Should the compartments be:				
A. In a separate room?	40	86.9	5	62.5
B. In the finishing room?	1	2.2	0	
C. In the main shop along the wall?	4	8.7	2	25.0
D. Under the benches?	0		0	
E. On a balcony if available?	1	2.2	0	
F. Other?	0		0	
G. No opinion.	0		1	12.5

15. What should be the height from the floor to the lowest shelf or compartment?

Table XIII

Frequency of Recommended Heights from the Floor to the Bottom Compartment

Frequency	Percent	Height
	A. High School	
1	2.3	1 ft.
1	2.3	7 1/4 in.
1	2.3	6 in.
2	4.5	4 to 6 in.
17	38.6	4 in.
5	11.4	3 to 4 in.
3	6.8	3 in.
2	4.5	2 to 3 in.
12	27.3	0 in.
2	4.5	no opinion
46		
	B. Junior High	
1	12.5	6 in.
2	25.0	4 in.
3	37.5	3 in.
2	25.0	no opinion
8		

16. What should be the maximum height from the floor to the top compartment?

Table XIV

Frequency of Recommended Maximum Height From the Floor to the Top Compartment

Frequency	Percent	Height
	A. High School	
1	2.2	8 ft.
3	6.5	7 ft.
29	63.0	6 ft.
5	16.9	5 ft. 6 in.
6	13.1	5 ft.
1	2.2	4 ft. 6 in.
1	2.2	3 ft.
46		
	B. Junior High	
1	12.5	7 ft.
2	25.0	6 ft.
2	25.0	5 ft.
1	12.5	4 ft.
2	25.0	no opinion
8		

Discussion of Data From the Questionnaire

In some instances the data are self explanatory and no discussion has been given. The information is simply used in the formulation of the final recommendations.

Part One of the Questionnaire

Question three indicates that approximately nine out of ten high schools and 6 out of 10 junior highs find that storing the large

project is an unsolved, or at best, unsatisfactorily solved, problem. A cross check of data from question two and three further revealed that, of the five high schools reporting no problem, four scheduled three or less classes in woodworking. On the junior high level, the minimizing of the problem seems to be more attributable to the smaller size of the projects made rather than to the number of classes.

Question four shows a surprisingly wide range of projects on hand. However the author noted during the interviews that, in schools where the storage problem was particularly acute, there was a tendency for the instructor to discourage the construction of large projects. Of course there were exceptions. In a few shops, it was difficult to see where the student found room to work without falling over another student's project. In instances where the number of projects on hand is exceptionally high, it was often caused by the policy of retaining all projects in the shop until the end of the year in order to make a display for an open house or some similar occasion. Schools with an adult evening program in the shop will invariably have a project load considerably heavier than normal, especially since an adult group usually selects a higher percentage of large projects than do the regular classes.

In the high schools the ratio of "large" projects to pupils ranged from 7.4% to 83.3%. (Read 7.4% of the pupils can be expected to have a project too large to remain in their locker...). The mean of the ratio was 29.69%, the median 29.1%; the standard deviation

is 3.6%. These figures indicate that one may expect about one large project for each three pupils enrolled in a typical general woodshop program on the high school level.

The range of the junior high student project ratio was 6.7% to 70.8%. The mean was 29.96%, the median 11.9%, standard deviation 30.5%. These figures indicate that the sampling of junior high schools was too small, statistically, to establish reliable figures for projects on hand. One junior high instructor indicated that, ordinarily, he had very few large projects on hand; but occasionally there would be as many as 75 end tables at one time. He used a controlled program in which all his pupils made the same project at the same time.

Question 5. If the question had been asked: "Were planned facilities for project storage available?" the answer would have been 80 to 90% negative.

Question 6. The most noticeable feature about facilities for project storage in nearly all the shops is that it is a case of anywhere space can be found where the project would be more or less out of the way. There is very little evidence of areas planned for project storage in the original shop plan.

Question 7. Concerning storage space available, ten instructors stated they had none; that is, no place where they could store projects except in the working area of the shop. The average total space for storage of large projects reported was: high school, 288 square feet; junior high, 294 square feet.

Question 8. Do the facilities allow safequarding the projects? Safeguarding the projects: "As a whole" meant a separate storage room or finish room which could be locked. "By class groups" meant separate rooms or enclosures for each class. "individually" meant separately locked cabinets capable of storing large projects. The one instructor who had some storage area of this type used it for the storage of the night-school adult class. "Not at all" meant no protection other than by locking the entire shop.

Question 10. It is the author's belief that while in some cases reorganization of present shop space could result in improved project storage, the only solution for most schools is the question of a new shop, or of an extension of the present structure.

Question 11. The question was modified by the interviewer to: "Do you find it difficult to prevent damage to the projects because of lack of proper and adequate storage facilities?" The fact that only 15.2% of the high school instructors and 25% of the junior high instructors claim to have no appreciable damage is one of the strongest recommendations for an improvement in the planning of storage facilities for large projects.

In reply to the question, "What happens when a nearly finished project is damaged?", Professor E. D. Meyer of the Industrial Arts Staff at Oregon State College, said, "You (the instructor) frequently find yourself with two problems: 1. What to do with an unfinished, unwanted project. 2. What to do with an unhappy and disinterested pupil."

In the same vein, Professor Emanuel E. Ericson (2, p.91), University of California Santa Barbara College writes:

> 6. Are there adequate locker facilities? A place where the student can keep his unfinished work is a valuable factor in student morale. To lose work upon which hours of patient effort have been expended leads to discouragement and dissatisfaction.

Part Two--Criteria

Question 1. The individual compartment for each project is recommended because it is the best way of preventing damage to the projects.

Question 2. Several instructors remarked that group compartments would be next choice if individual compartments could not be had.

Question 3. Wood was first choice of material for locker construction because: 1. Wooden compartments are less likely to mar the projects. 2. The cabinets could be more readily constructed in the shop than they could if made of metal. 3. Changes could be made with greater ease. 4. Wood is, in this area, a local product and comparatively less expensive. 5. Wood is quieter. 6. Wood construction is easier to repair (in the woodshop).

Question 4. The use of doors for a group of compartments to be used by a class was favored, rather than doors for each compartment, because of lesser problems with locks and keys, and less chance of

damage from doors striking against projects being placed within the compartments. However it has the disadvantage of making the storage area less flexible.

Question 5. The solid door is slightly the favorite. The reasons given for preference were better appearance, durability, and a better safeguard; also the solid door is relatively dust-tight. Where the wire mesh doors were preferred, the reasons given were: easy to check contents of compartments, better ventilation, and students frequently find inspiration from the projects of others.

Question 6. There was a majority preference for hinged doors but it seemed to be largely a matter of personal choice as few instructors said why they did prefer them. One stated he had trouble with sliding doors jamming when projects (lamps or other top heavy projects) fell against them. Those who preferred the sliding door did so because it would not be in the way as much as the hinged type. One instructor specified the doors should slide upward.

Question 7. All instructors were asked to express an opinion on hinge location even when the preference was for sliding doors.

A. Individual compartments: Top hinging, does not stand open.
   Side hinging, does not have to be held open.
   Bottom hinging, less in way and does not have to be held open.

B. Class compartments: Too large to hinge anywhere except on side.

Question 8. No need for double door on smaller compartments; single door is simpler and less expensive.

Question 9. Group compartment too large for single door, because of swing space and weight on hinges.

Question 10. Not much reason to put on a door if it does not have a lock. Locks should be cabinet locks, not padlocks.

Question 11. In the typical program the size of the projects vary and so should the storage compartments designed for them, in order to conserve space.

Question 12. The instructors have observed that most of the larger projects tend to fall roughly into two or three size classifications. The spread shown in the size recommendations tabulated in Tables I through IX are based on instructors' particular experiences. If only one or two desks or tables were made in an instructor's shop over a period of several years, he would not feel justified in making compartments large enough to contain such projects.

No attempt was made in the tabulation to divide the second size compartment into the sizes recommended by those suggesting only two sizes as compared with the dimensions given by instructors desiring three sizes. The recommendations averaged nearly the same for both groups of instructors.

Question 13. The frequency curve of Table XI tends to be bi-modal because of not segregating the recommendations into two groups. The table serves the purpose of estimating relative numbers of different sizes of projects, and therefore does not require extensive breakdown.

Question 14. Many of the men recommending a separate room also stipulated that it should be adjacent to the finishing room, if possible; and of course it should have a glassed partition.

A number of the teachers expressed a definite "No" to using the finishing room for project storage. This would mean too much dust-raising traffic in and out of the room. The "under-the-benches" location was considered as "just not adequate" for storage of large projects.

Balcony storage meets with little favor due to the difficulty of carrying large projects up and down. However, several of those interviewed believed a balcony to be acceptable as a location for individual student lockers.

Question 15. Locating the lowest compartment above the floor level is favored for appearance, to facilitate sweeping, and to avoid damage should the floor be flooded due to broken pipes or other cause. One person suggested a 1 x 4 or 2 x 4 on edge for the toe board, since that would allow a standard push-broom to slide freely under the over-hang. Those who recommended that the lowest compartment be at floor

level wished to avoid the necessity of lifting the larger projects to put them into the compartments.

Question 16. The feeling here was to avoid the use of ladders or stands since their use would constitute a potential source of accidents. The consensus was that six feet is the maximum height at which most high school students could handle a project without the use of a ladder or stand.

Other suggestions:

A permanent (fixed) rack suspended from ceiling or posts for storing minimalic construction.

"Lifts" for storing boats and minimalic projects.

Build boats only if special room is available where they may remain on horses.

Boats remain on horses in shop assembly area.

Storage room might be combined with gluing area.

Rollers in bottom of large compartments to ease movement of projects.

A number suggested that the project storage room be located so as to be as nearly dust-free as possible.

Others recommended equipping the largest compartments with dadoes or cleats to take a shelf and/or partitions, to increase flexibility.

Raise chests of drawers and the like off cement floor by platform, to prevent dampness from getting into glued joints.

Use light canvas to cover projects not in storage compartments.

Arrange storage compartments by groups, according to quality of project instead of by class.

Have a few compartments in finishing room, for projects just finished.

Storage room should be large enough to allow floor space for the "outsize" project that cannot be stored in any of the cabinets.

Provide one compartment in the storage room for archery bows-- about 6 feet high, 1 foot wide and 2 feet deep.

CHAPTER IV

SUMMARY AND RECOMMENDATIONS

This study was undertaken in an effort to arrive at a solution to the ever present problem of storing large projects in the woodworking laboratory. In order to accomplish the purpose of the study it seemed best to use the personal interview method for gathering data. A questionnaire was drawn up to serve as a check list and to make certain that the same ideas would be covered at each interview. Interviews were conducted with 54 instructors in the woodworking laboratories of secondary schools, within reasonable driving distance of the college. Available literature in the field was searched for information and suggestions bearing on the problem.

SUMMARY

The data and the opinions gained show that, in a great majority of the shops visited, the large project presents a major storage problem.

Frequently allied with the problem are such matters as:

1. Project damage
2. Pupil attitudes
3. Shop appearance
4. Accident hazards

A general summary of the findings follows:

1. The typical program for Oregon secondary school woodshops is of a general nature. It includes bench and machine work and cabinet construction; in some instances a carpentry unit is added.

2. The average high school woodworking class has approximately 20 pupils. The number of such classes averages 4.89 a day. The averages for junior high schools are 5.13 classes a day and 19.4 pupils. Both types of school average nearly 100 pupils a day (total) in woodworking classes.

3. Nearly 90% of the high schools and more than 60% of the junior high schools reported that large project storage was a definite problem, with a running average of more than 26 such projects to be stored.

4. Three-fourths of the shops have facilities of one type or another for storing projects; however, nearly the same proportion reported the space inadequate. The average space reported was less than 300 square feet.

5. Space used for project storage is usually a matter of, "It has to go somewhere; let's put it over there for the time being."

6. Too often there is no provision for safeguarding projects other than locking the shop. This applies to more than two thirds of the shops visited.

7. Nearly all instructors recommend separate compartments or cubicles for each large project. Three-fourths favored arrangement of compartments by class groups.

8. About three-fourths of the instructors favored wooden construction for lockers or compartments.

9. Nearly 85% of the high school instructors and 75% of those in junior high schools want doors on the cabinets. Of these men, 76.9% in high schools and 100% in junior highs prefer that the doors enclose a class section. Also, more than three-fourths of all these instructors wanted locks, if door were to be used.

10. Whether the door construction should be solid or a frame with wire mesh, sliding or hinged, are largely matters of personal preference, but a solid door hinged on the side was the selection of the majority.

11. It was the concensus that individual compartments should have single doors, and class areas should have double doors.

12. Compartments of more than one size are favored by 87% of the high school instructors and 50% of the junior high teacher; three different sizes were most frequently recommended.

13. Data from Tables I to IX indicate the bottom (or large) compartment should be 3 feet high by 4 feet wide and 2 feet deep. A depth of 2 feet 6 inches also received strong recommendation. In the case of medium-sized compartments, 2 feet high, 3 feet wide and 2 feet deep was the recommendation. Specifications for the small size were 2 feet for all three dimensions, except that a width of one and a half feet was favored by many.

14. Tables X through XII indicate that the three sizes should be distributed as follows: 20% large, 30% medium, 50% small.

15. Facilities for large project storage should be in a separate room.

16. The storage cabinet should have a base, or toe board, approximately 4 inches high.

17. The bottom of the top compartment should not be more than 6 feet from the floor.

18. The storage room should have sufficient floor space to allow for a few projects of unusual dimensions.

RECOMMENDATIONS

The following recommendations are made as an aid in planning the project storage area of an industrial arts woodshop:

1. Provide a separate storage room adjacent to the finishing room, allowing at least 9 feet of available wall space for each class-storage-unit desired. In order to allow free floor space for over-sized projects, the room should be not less than 15 feet wide. The partition between the storage room and the main shop should be glazed. A room 15 feet by 18 1/2 feet would provide for four class groups.

2. Construct compartmentalized cabinets to house and safeguard projects. (See suggested plan in the Appendix).

3. Construct two additional class units if a night school adult class is to use the facilities.

4. Use doors with a cabinet-type lock to enclose each class-section of cabinets. Solid doors give the best all-around

service. Use sliding or hinged doors according to preference--sliding doors take less room, make more space available for over-sized projects, but must slide upward unless cabinets are built in pairs.

5. The space from the top of the cabinets to the ceiling should be enclosed to provide cabinets for storing supplies or articles used only occasionally.

6. Provide a fixed rack, suspended from the ceiling or on columns for miniralic projects.

7. Store boats on horses or special frames. Lifts are too dangerous for junior and senior high school use.

Various factors will, of course, affect the actual project storage needs for any particular shop. For instance, a beginning class might not require any provision for large project storage. Some schools with only two or three classes of woodworking per day, might find it better to use no doors, or else to use a door on each compartment in order to increase the flexibility of the storage area. Because advanced classes tend to make more of the large type project than do beginning classes, it might be advisable to use separate doors on the bottom (large) compartments, and to enclose the upper tiers as class sections. Further flexibility should be built into the unit by placing cleats or dadoes in the bottom compartments, so that a shelf and/or partitions could be placed therein as needed. Each class unit should be housed in a separate cabinet so that, should the need arise, it could be moved without destroying it.

The greatest dimensions of the bottom (large) compartments run parallel to the wall instead of at right angles to it, in order to prevent the succeeding tiers from being too deep and thus making it

difficult to remove projects. Also, if the smaller compartments were too deep, there would be a tendency to store more than one project in each, and thereby partially defeat the purpose of the storage unit.

The use of a separate compartment for each project is the only way to prevent the possibility of one project being accidently struck and damaged as another project is being placed in the unit. Actually the partitions will, in most cases, allow projects to be stored closer to one another without damage than when partitions are not present.

In order to obtain the proper balance in construction, the suggested cabinet is slightly modified from the dimensions previously suggested by the survey report. The bottom compartments are 4 1/2 feet (outside dimensions) instead of 4 feet. This allows for 3 three-foot compartments in the second tier. The third tier consists of 3 two-foot cubicles and 2 compartments 18 in. in width. The percentage relationship thus agrees with that resulting from Tables X to XII, which is twenty, thirty, and fifty percent, respectively, for the large, medium and small compartments. The plan is not intended to be a rigid specification, but a general recommendation that should fit the average program.

The class-group cabinet would contain ten compartments which, considering the "one large project to three pupils" ratio, should be ample for the average class. It is expected that instructors may modify the plan to fit the individual needs. In one shop located in the heart of a large hunting area, the construction of large gun cases

is undertaken by several students each year. An instructor in such a situation might do well to plan a number of compartments to hold even so large a project.

Minimalic projects present a unique problem inasmuch as they do not fall readily into size classification. They are as varied as are full-scale houses. They are relatively light and do not have highly finished surfaces. Therefore they are less subject to damage than are the other types of projects. The storage of these projects on an open, fixed rack seems to be the most practical answer.

Boats and paddle boards, under ideal conditions, should be constructed in a separate room where they can remain undisturbed on horses or special frames. However, this seems to be a great deal to hope for, and they will probably remain in the main shop assembly area. On the survey only one such shop was visited. The Springfield High School has a separate room, 20 feet by 30 feet, for boat construction.

The recommendations made in this study should, if adopted, provide storage for at least ninety percent of the projects constructed in the typical school shop. Under these circumstances, the few remaining over-sized projects will not constitute a serious problem.

The size of the storage room needed would vary according to the number of classes using the shop. A room 15 feet by 22 feet would allow space for five class-unit cabinets as well as for a number of over-sized projects. A room of 20 feet by 24 feet would provide for

eight class-units and space for several over-sized projects. (See the suggested storage room floor layout in the Appendix).

While many administrators will wonder if the expense of constructing such storage facilities is justifiable, the author believes the need justifies the cost. Actually the space requirements for such a plan are modest. One leading teacher* of industrial arts, recognized to the extent of service on the industrial arts course of study committee since 1935, by appointment from two State Superintendents, recommended, during the interview, that ten square feet of storage space (shelf or locker area) for project storage, be allowed for each pupil. The area per pupil suggested in this study amounts to less than five square feet.

The improved appearance of the shop would result in better work habits and attitudes of the students, and a better impression on visitors. Loss or damage of projects would be practically non-existent. Working areas would not be encroached upon by projects from other classes. The difficulty of cleaning the shop would be greatly reduced.

Considering the fact that an industrial arts program is admittedly expensive, it seems only reasonable that a few hundred, or even a thousand dollars, could well be invested to gain the advantages enumerated above.

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* O. N. Mickelson, Eugene High School.

While the project is not the total educational objective of the industrial arts program, it is the student's objective. Nearly everything taught the pupil is taught through the medium of the project. If the student loses interest in the project, he probably loses interest in the entire class procedure. All chance of obtaining the educational objectives of the program is likely to be lost at the same time. Therefore every effort should be made to protect the student's project, and thus protect his interest and the effectiveness of the learning situation.

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APPENDIX

School: _____

Instructor: _____

QUESTIONNAIRE

1. Type of woodworking program:
   General _____ Cabinet _____ Carpentry _____.

2. How many classes? _____ Total enrollment _____.

3. In these classes is there a problem with the storage of projects too large for pupil lockers, during assembly and finishing stages? Yes _____ No _____

4. Approximately how many such projects are apt to be on hand at one time? _____

5. Are there facilities for storing such projects?
   Yes _____ No _____

6. What are these facilities? Open shelf _____ Large Compartment _____ Storage room _____ Balcony _____
   Other _____

7. How many square feet of space is available for this purpose? Shelves _____ Cabinets _____
   Floor space _____ Other _____

8. Do the facilities allow safeguarding the projects?
   A. As a whole? _____
   B. By class groups? _____
   C. Individually? _____
   D. Not at all? _____

9. Where is the space located?
   _____

10. Do you find the space adequate?
    Yes _____ No _____

11. If no space is provided for this purpose, do you find it difficult to prevent damage of the larger projects?
    Yes _____ No _____

Remarks:

School _____

CRITERIA FOR "IDEAL" STORAGE COMPARTMENTS

1. Should the storage be individual compartments? _____

2. Should the storage be group compartments (for each class)? _____

3. Should the compartments be made of
   A. wood? _____
   B. Metal? _____
   C. combination? _____

4. Should the compartments have doors? _____
   A. Each compartment separately? _____
   B. Group of compartments for class? _____

5. If doors are used, should they be
   A. solid? _____
   B. frame with wire mesh? _____

6. Should the doors be
   A. sliding? _____
   B. hinged? _____

7. If they are hinged, where should the hinges be located?
   A. Individual compartments: top _____, side _____, Bottom _____.
   B. Group or class compartments: top _____, side _____, bottom _____.

8. Should individual compartments have
   A. single doors? _____
   B. double doors? _____

9. Should group or class compartments have
   A. single doors? _____
   B. double doors? _____

10. Should the doors have locks? _____

11. Should the compartments all be the same size? _____

12. What size or sizes would you recommend?

Height __ft.__in.	Height __ft.__in.	Height __ft.__in.
Width __ft.__in.	Width __ft.__in.	Width __ft.__in.
Depth __ft.__in.	Depth __ft.__in.	Depth __ft.__in.

School _____

13. Percentage of each size recommended.

_____ _____ _____

14. Should the compartments be _____
    A. in a separate room? _____
    B. in the finishing room? _____
    C. in the main shop along the wall? _____
    D. under the benches? _____
    E. on a balcony if available? _____
    F. other? _____

15. What should be the height from the floor to the lowest shelf or compartment? _____ft. _____in.

16. What should be the maximum height from the floor to the top compartment? _____ft. _____in.

Have you any other suggestions for the storage of large projects?

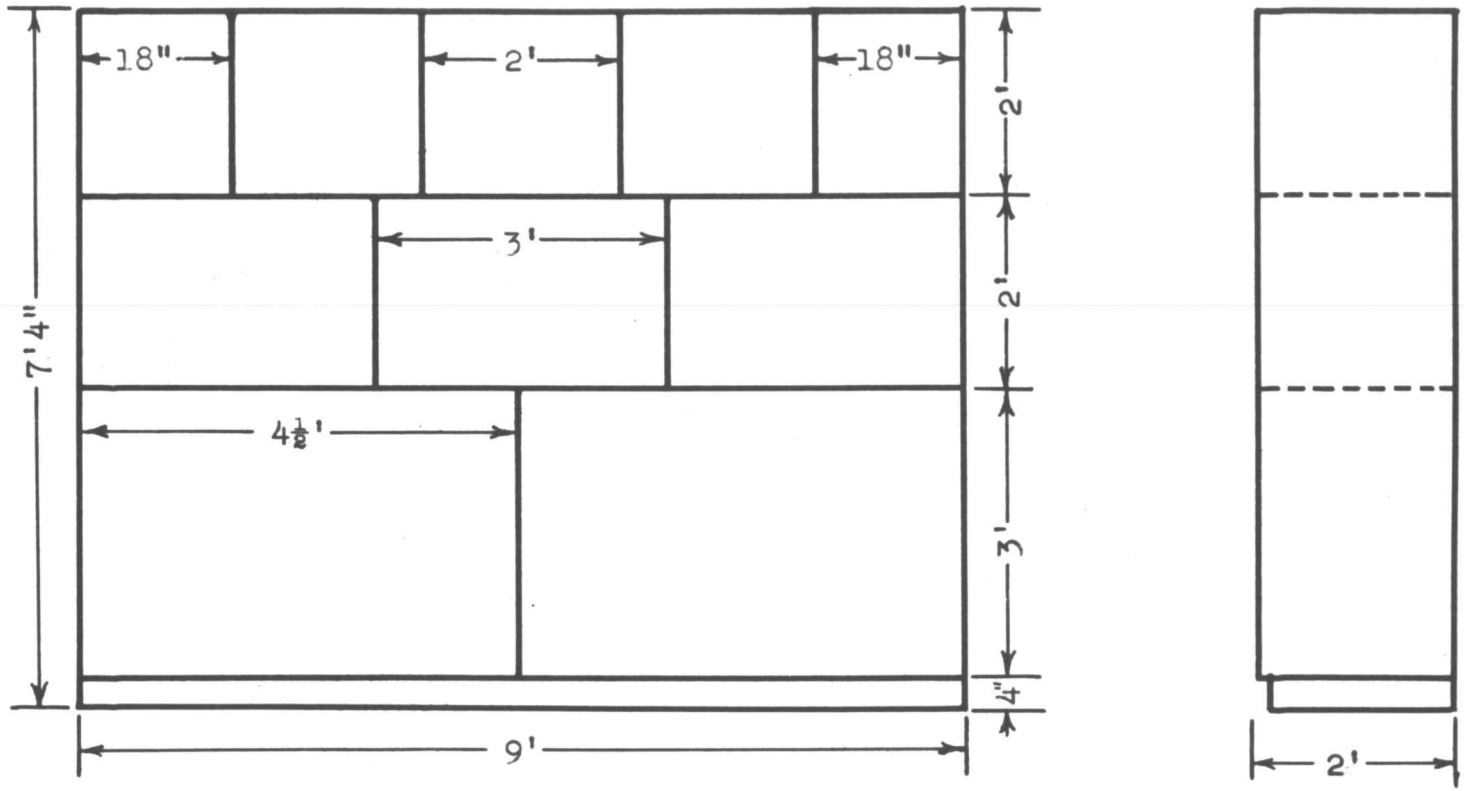
Appendix B

List of Schools Visited and Instructors Interviewed

Location	School	Instructor Interviewed
Albany	Albany High School	Mickelson, W. C.
	Albany Jr. High School	Eliassen, Sven
Astoria	Astoria High School	Eliassen, John
	John Jacob Astor H. S.	Thompson, Philip
	Lewis & Clark Jr. H. S.	Hyde, Albert
Bandon	Bandon High School	Davis, Dale
Beaverton	Beaverton High School	Barnard, James
Bethel	Willamette High School	Hinckley, Edwin C.
Canby	Canby High School	Hale, R.
Coburg	Coburg High School	Peterson, Richard
Coos Bay	Coos Bay High School	Landis, Alfred
Coquille	Coquille High School	Snider, Paul
Corvallis	Corvallis High School	Saling, Neil E.
Dallas	Dallas High School	Barnes, John E.
Elmira	Elmira High School	Menegat, Reginald
Estacada	Estacada High School	Blake, Harry J.
Eugene	Eugene High School	Mickelson, Odin
	Collin Kelly Jr. H. S.	Warren, Roy C.
	Theo. Roosevelt Jr. H. S.	Johnson, Robert S.
Finn Rock	McKenzie River High School	Klick, Lamont
Florence	Siuslaw High School	Frasier, Chas. W.
Forest Grove	Forest Grove High School	McCauley, Versel
Gresham	Gresham High School	McKay, Albert
Hillsboro	Hillsboro High School	Ruud, Syver

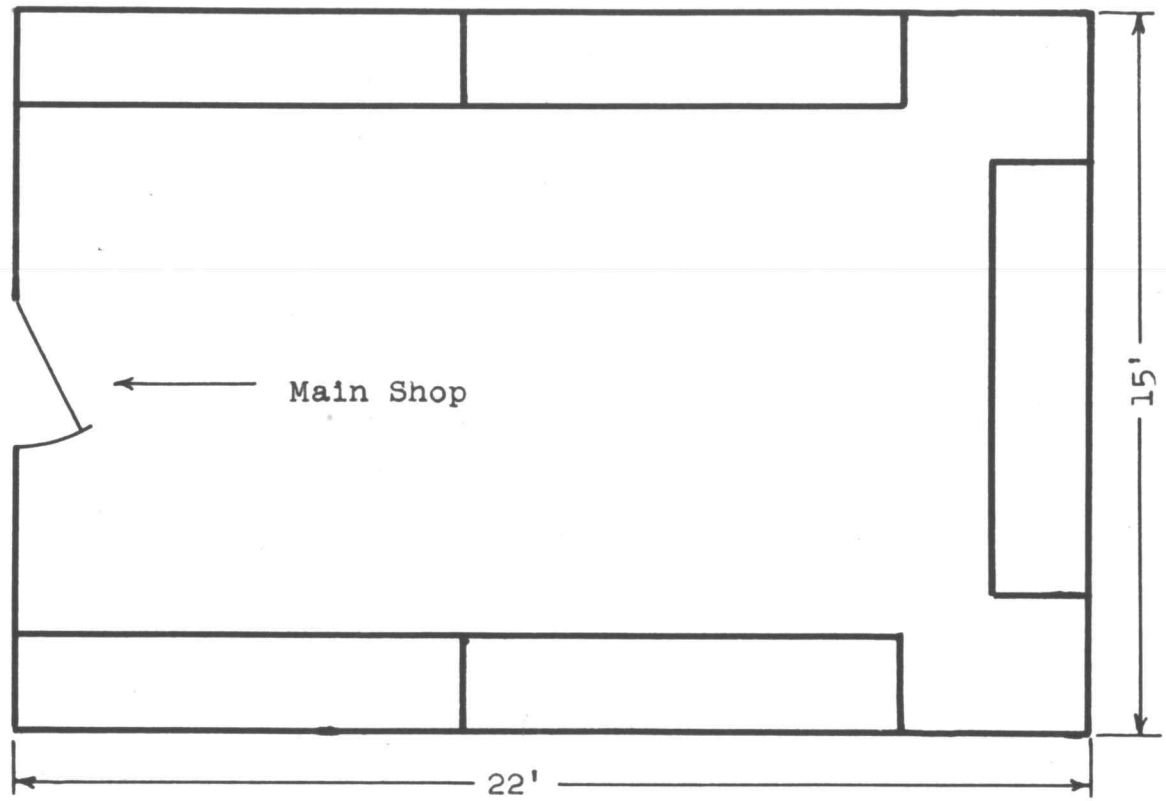
Location	School	Instructor Interviewed
Lebanon	Lebanon High School	Gardner, Royal
McMinnville	McMinnville High School	Asbury, Gordon
Mapleton	Mapleton High School	Dexter, Lewis
Milwaukie	Milwaukie High School	Moore, Leonard
Monmouth-Independence	Monmouth-Independence High School	Robinson, Paul
Myrtle Creek	Myrtle Creek High School	Fanger, Franklin
Myrtle Point	Myrtle Point High School	Neugart, Ray
North Bend	North Bend High School	Taluc, Otto
Oregon City	Oregon City High School	Rayl, John
	Oregon City Jr. H. S.	Bentz, Gale
Portland	Cleveland High School	Ely, Glen H.
	Franklin High School	Horr, Neal L.
	Grant High School	Butler, Cyril, G.
	Jefferson High School	Peterson, Floyd L.
	Roosevelt High School	White, Robert L.
	Washington High School	Tuttle, Cecil A.
Roseburg	Roseburg High School	Edie, Roland L.
Salem	Salem High School	Davis, Marion R.
	Leslie Jr. H. S.	Anderson, Robert C.
	Parrish Jr. H. S.	Dawson, Donald J.
Sandy	Sandy High School	Anderson, Erland
Seaside	Seaside High School	Davidson, John
Silverton	Silverton High School	Gates, William
Springfield	Springfield High School	Roner, Joseph
Stayton	Stayton High School	Avey, Cloyce
Sweet Home	Sweet Home High School	Roberts, Verlin

Location	School	Instructor Interviewed
Tigard	Tigard High School	Bishop, Merit
Tillamook	Tillamook High School	Turbyne, John
West Linn	West Linn High School	Oppenlander, H.
Willamina	Willamina High School	Sedlacek, Franz

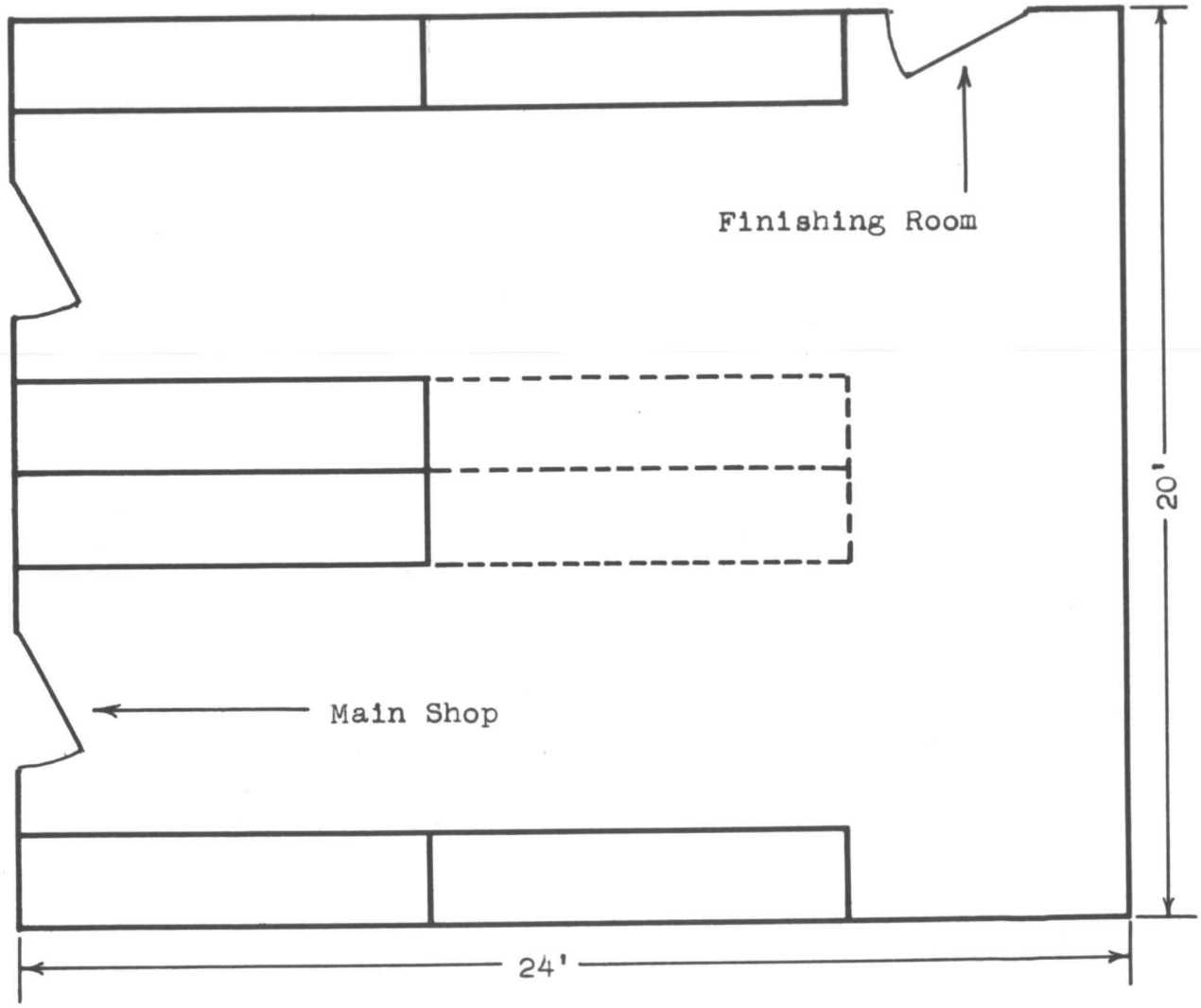


Note: Doors to be used may be either hinged or sliding. Slide the doors upward unless the units are in pairs. This allows the full opening of each unit. The bottom compartments could be enclosed with separate doors. Place shelf supports in the lower compartments to increase the flexibility of the unit.

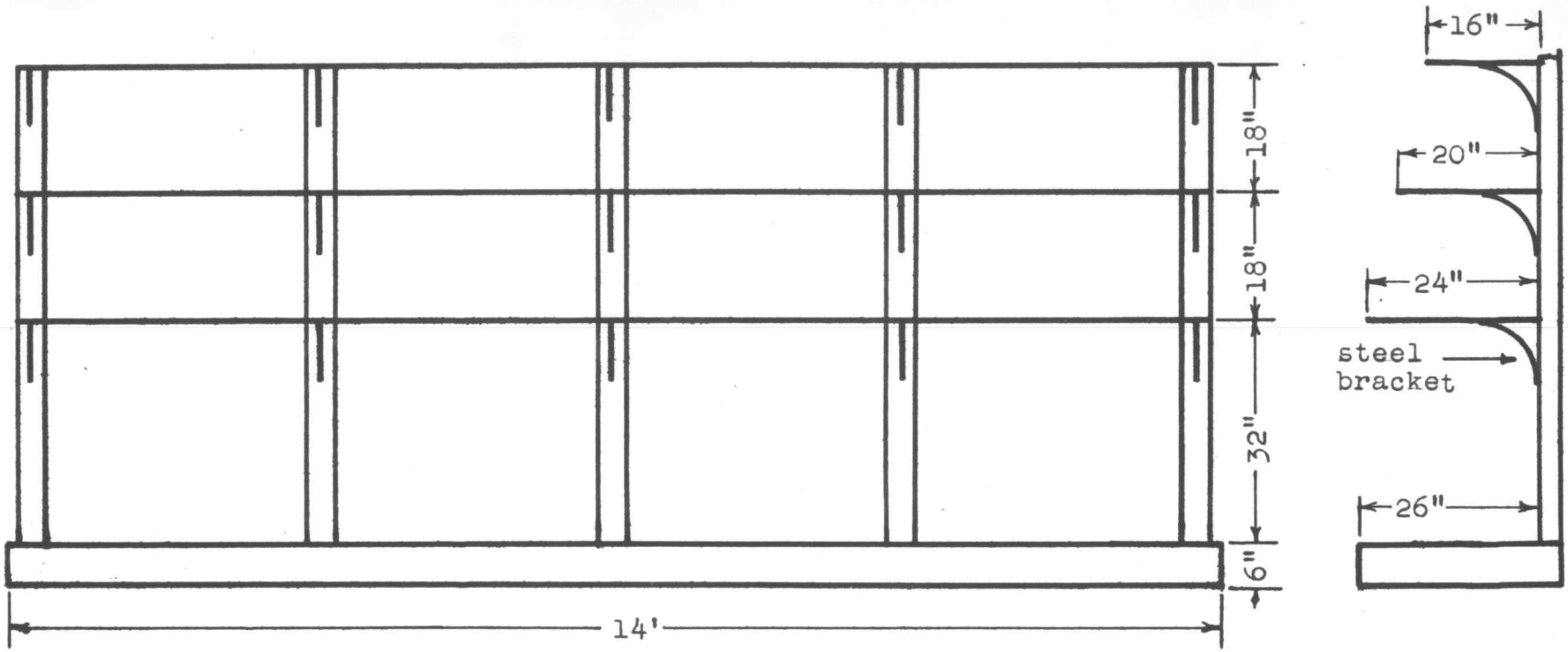
PLAN FOR CLASS STORAGE UNIT



STORAGE ROOM FOR FIVE CLASS UNITS



STORAGE ROOM FOR SIX OR EIGHT CLASS UNITS



Note: Economical storage shelves for industrial arts-shops. These allow for the storage of heavy and light articles of various sizes.

Drawing from D. M. Schweickhard.

STORAGE SHELF SPACE FOR UNFINISHED PROJECTS